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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 23 — NEW YORK, THURSDAY, MARCH 15, 1900 — NUMBER 11

Published at 218 William St., New York,
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

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Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$3 per year in advance, postage paid, in North America.
$4 per year in foreign countries, postage prepaid.
No back numbers beyond current year.
For sale by newsdealers, generally.

CHAS. CHURCHILL & CO.,
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Entered at New York P. O. as second-class mail matter.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Home-Made Machine Tools.

The remark of a prominent tool builder who was going through a machine shop the other day may be found instructive to many. Stopping before a special machine that had been built in the shop where it was being used, and for performing a certain manufacturing operation, he watched its working for a few minutes and examined the work it was doing, then he said: "Now, if I or any other tool builder were to build for these people such a tool as that, do you suppose for one moment that they would accept it and pay me for it? By no means; they would try it for a few days and then throw it out as utterly unsatisfactory, unfit for the work and a disgrace to their shop. But having been built here and having enlisted the interest of the superintendent, the foreman, the proprietor and the man who runs it, it is made to do; its many and manifest shortcomings are ignored or excused, and the machine is not only kept in service, but its miserable performance is actually extolled and the machine bragged on."

Just here the tool builder touched a point of human nature. It is perfectly easy to understand why things should go as he described them. The man who buys a machine to do certain work is generally a sharp critic of that machine; the least fault, even though it be so small as to be mainly imaginary, is magnified; no apology is made for it, and the builder hears by next mail that the result of all his careful planning and study of the machine is a worthless contraption that he can come and take away as soon as he pleases. But how different it is with the home-made tool. Its idiosyncrasies are borne with and excused; it has a larger or a smaller pulley put on it here and a new gear or a new spindle there, and finally, when it is made to work after a fashion, it is pronounced an unqualified success. This throws some light also upon the reason why tool builders so often fail to take up for manufacture and sale tools that have been thus constructed in the shops where they are used, and which are thought by their constructors to be something in the nature of a wonder that any tool builder ought to be glad to get hold of. The tool builder simply knows that the tool is in the hands of its friends, who are bound to make it work successfully, if such a thing is at all possible; whereas if he builds it, he knows that it will go into the hands of men who will be interested no further than in seeing that the machine "goes" without trouble from the start, and who will in many cases excuse no defect or apparent shortcoming, but will immediately conclude, if they can find any fault with it whatever, that they have not got their money's worth. It makes a great difference with a machine whether it is in the hands of its friends or of those who may be its enemies, or at least indifferent to it.

We are not prepared to say that this feature of the machine-tool business is on the whole a bad one. It has its manifest advantages. It occasionally leads to the development, step by step, of a machine tool that is finally made an all-around success, and which perhaps no tool builder would have been sufficiently interested in to have stuck to it until it had been perfected; while, on the other hand, the expectations and requirements of customers are among the principal incentives to strive for perfection of detail. We mention the matter simply because it is, we think, interesting, and when fully recognized enables one to take some things philosophically that might otherwise not be so taken.

The Future of the Gas Engine.

The recent consolidation of gas and electric lighting interests in New York city, and the proposals made some time ago that certain electric lighting and electric railway systems pool their current, taken in conjunction with the progress that has been made experimentally toward the production of gas from garbage, as well as from coal, at greatly reduced cost, are suggestive of important developments that may take place in the methods of obtaining and using power. In this matter the Westinghouse manufacturing interests have come out and assumed a bold stand. Mr. George Westinghouse, in a letter to the "New York Times," has criticised the partially executed plans of the several electric lighting and railway companies who are to have on the east side of this city generating plants aggregating 375,000 horse-power as wasteful, and likely to stand in the way of vast public interests. He would have these companies unite in an enterprise to derive current from a common plant, and intimates that in generating power they might avail themselves of gas engines fed with fuel gas derived from garbage. The production of a very valuable fuel gas from garbage, he affirms, has been well demonstrated on a small scale, and is rapidly being brought to a commercial basis. Soft coal may be converted into a gas suitable for power and heating purposes in the same apparatus and by the same process.

Responding to this letter, Prof. R. H. Thurston takes a sanguine view of the increased application of gas for many purposes that will follow its economical production from refuse.

The Westinghouse companies have officially committed themselves to a radical view of the gas engine future in the pamphlet that they have issued—"A New Industrial Situation." It is here claimed that the gas engine can satisfactorily adjust the relations between gas and electric lighting systems by using the gas to run engines connected to electric lighting generators, and with an undiminished illuminating effect have left 60 per cent. of the present gas output for other purposes. In street railway work coal can be made into gas at a central plant and piped to sub-stations, corresponding to the trans-

former stations under the present electric system, and here used to generate a current by means of gas engines with an economy estimated at 50 per cent. It is not quite clear, however, whether this saving is possible under present conditions, for the new industrial situation is expected to result from experiments which have been long and carefully conducted, and which are stated to justify the belief that within a short time gas will be commercially produced and sold at a cost below the lowest price that now prevails in any part of the world. "Then the gas engine will gradually supplant the steam engine." All this is the more significant as it emanates from a party prominently engaged in building steam engines as well as gas engines, and which is not likely to give its endorsement to chimerical notions. It is not to be believed that Mr. Tesla's electrical patents of which the Westinghouse Company avails itself have carried on them enough microbes of S nday newspaper engineering to affect the constitution of that robust organization.

Meeting of the Junior Mechanical Engineers.

The monthly meeting under the management of the junior members was held at the house of the American Society of Mechanical Engineers on March 6. Mr. F. E. Frothingham, secretary of the local junior association, presided. The paper of the evening, presented by Mr. B. C. Ball, on "Cylinder Proportions of Compound Engines," was highly suggestive and valuable, and well worthy of a permanent place in the Transactions of the society. The discussion of the paper, which was participated in by Messrs. Kent, Rockwood, Frank H. Ball, Herreshoff and Frothingham, was also of an unusually high character. The attendance was fair, but not as large as it should have been, and those who were not there certainly missed an occasion of stimulating professional intercourse.

For an Ericsson Memorial in Philadelphia.

The Philadelphia Ledger announces that a generous citizen, whose name is withheld, has given $5,000 toward a fund for the erection in Fairmount Park of a worthy memorial to Captain John Ericsson. The sum proposed to be raised is $35,000. The enterprise must commend itself to patriotic citizens of every class, and especially to all mechanics and engineers. The memory of Ericsson is to be highly honored for two very distinct reasons. He was not only fortunate in being able to put forward at a most critical time one of the decisive agencies in the saving of the national life, but he was also, by his general record in the front rank of the world's great engineers and inventors. The "Monitor," the first turreted war vessel ever in action, whose success revolutionized the naval architecture of the world, was but one of many inventions, although it alone secured a marked and enduring place in the world's history.

To European Subscribers.

This issue of the "American Machinist" is the last that will be mailed from America. The issue dated March 22 in America will issue from London under date of April 7. After this first delay of a few days the paper will come regularly on Saturdays. Do not imagine you have missed the March 29 issue; its contents will appear under date of April 14. You will have the consecutive numbers from 1 to 52.

The "American Machinist" hopes that the establishment of an office and mailing depot in Europe will increase its business there and enable it to better serve its friends across the sea.

Engineering Association of the South

A meeting of the Engineering Association of the South was held at Nashville, Tenn., February 8, when a paper was read by Maj. E. C. Lewis upon the "Nicaraugua and Panama Canal Routes." His conclusions favored the Panama route, for the reasons that the bed of the canal would be at a much less hight above the sea level, necessitating fewer locks; deep harbors of a permanent character were at the termini; the length of the canal was far less, affording quick passage of ships, and the canal was already about half completed with all necessary equipment for its completion on the ground.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(5) R. J. S,. Davenport, Iowa, writes: We have an exhaust fan for polishing room with main pipe 25 inches in diameter at fan and 12 inches at small end, 50 feet long. There are thirty-two openings, 4 inches in diameter; speed of fan 1,000 revolutions. Please let me know if this fan requires most power to run it with the openings closed or open, and why. A.—It requires most power with the openings open, because in that case air is being drawn into them and work done upon it by its being compressed and put in rapid motion, whereas if the openings are closed what air comes into the fan case stays there and simply is driven around by the fans, there being practically no work to be done after that except to overcome frictional resistance.

(6) E. B., St. Louis, Mo., asks: With what force does the piston in a pneumatic hammer strike the chisel, stroke of hammer being, etc.? and please give also formula to figure that out or any other stroke by given diameter and air pressure. A.—The blow of a hammer should not be expressed in terms of force, measured in pounds, but in terms of energy or work measured in foot-pounds. (See letter of Wilfred Lewis, in "American Machinist," June 12, 1890.) The average or maximum force of the blow might be determined experimentally by means of a special dynamometer. The average force might be very roughly computed if measurement were taken of the space traversed by the hammer between the beginning of its concussion and the complete checking of its movement, or if we knew the length of time required in bringing it to a stop. But as these quantities are in this case inconveniently minute, and as there is a great lack of uniformity in results owing to varying conditions of resistance, elasticity, etc., which have a direct bearing upon the problem, such determinations of force would be of little value as a standard. It is evident that if the object struck by the hammer, as well as the material of the hammer itself, were non-elastic and unyielding, the force of the blow, however little momentum the hammer might possess, would be infinite.

The Newark (N. J.) "Evening News" proposes that the city of Newark hold an industrial exposition or fair in 1902. It refers to the achievements of that city in 1872, and the proposed fair is evidently intended to show the progress made during the intervening thirty years. The city of Newark could make a very creditable industrial exposition if the exhibits were to be confined to the manufactures of that city alone. Its industries are perhaps more varied than those of any other city in this country, and it is one of the most important manufacturing cities of the country, though it is comparatively little heard of because it is located only nine miles from New York, and the business offices of a large number of its industrial establishments are located in the last-named city. Its importance as a manufacturing center is therefore not appreciated as it would be under other conditions. An industrial exposition would make its importance better understood.

The Niles-Bement-Pond Company, whose branch office for Great Britain has been at 39 Victoria street, London, S. W., for some years past, has now taken premises at No. 25 Victoria street, covering a floor-space of upwards of 3,800 square feet, and in addition has a large storage warehouse, and proposes to carry a large stock of machine tools of all descriptions. The business will remain under the charge of Mr. W. S. Accles, M. I. M. E., who is a practical engineer, and whose experience here and in Great Britain, as works manager and consulting engineer, qualifies him to advise with tool users regarding their individual requirements.

Commercial Review.

NEW YORK, FRIDAY EVENING,
March 9, 1900.

THE ENGINE MARKET.

Engine manufacturers are still supplied with all the work they need to keep them busy. One very confident assertion was heard to-day, that this is with old orders, and that new contracts are not coming in freely to take the place of those executed. Reports from representatives of leading builders in town do not confirm this view. They go to show that this year is almost duplicating last.

Deliveries are greatly unequal. While one company is taking few orders to be filled before next year, another concern is able to promise shipment in a few weeks or months. There are plenty of cases where builders are much cramped on deliveries, but in other instances some easing off is reported. The latter would indicate that the demand, except where accounted for by increased facilities, is not quite what it once was. Prices for the most part are inclined to keep along on a level.

The Harrisburg Foundry and Machine Company has been booking increased, rather than diminished, orders, in spite of advanced prices. A new advance, varying from 5 to 20 per cent., is just to be put into effect. The company can make somewhat better deliveries, owing to having gotten into its shops tools which were late in coming. Trade for this year to date shows a great improvement over the corresponding period in 1899.

The Baldwin Locomotive Works expect to break their locomotive building record —946, in 1891— by turning out 1,000 this year. At present 700 are on the books, a number unequaled, and 93 were shipped in February, notwithstanding the shortness of that month.

CANADIAN DEVELOPMENTS.

There are several indications at the present time of an inrush of capital and enterprise from the United States into Canada. Perhaps no public attempt has been made to draw any general deductions from the several large industrial projects that have matured or are maturing, but taken in conjunction they are not unsuggestive.

In the first place, there is the Dominion Iron and Steel Company, of which Mr. H. M. Whitney, of Boston, is the most conspicuous financier. This company was mentioned in the "American Machinist" last year. American machinery for the plant has been going forward several months. Much of it has gone from Pittsburgh or vicinity; some has been sold by Niles-Bement-Pond interests, the E. P. Allis Company furnish steam engines, the Higley Sawing and Drilling Machine Company is now shipping a cold sawing machine.

The Canadian Steel Company, lately incorporated, is another concern in which parties in the United States are interested, and which is thought to be an intended rival of the Dominion Iron and Steel Company. As announced in our last issue, page 49, it is reported to be contemplating the erection of a large plant somewhere accessible to Michigan ore. A statement has also been made that the Canadian Government is expected to admit machinery from this country for the works free of duty.

At Collingwood, Ont., arrangements are under way to establish a $1,300,000 plant, with blast furnaces having a capacity of 200 or more tons per day and mills for the direct manufacture of the raw metal into steel plates and other products. According to one report the Cramps, of Philadelphia, are interested in this project.

Copper smelting works costing $150,000 are contemplated by a syndicate of American capitalists for erection at North Sydney, Cape Breton, and H. B. Meech, a mineral expert from Boston, has been there for the purpose of selecting a site.

The cement industry is reported to be coming into prominence in Canada. An engineer connected with a prominent New York firm stated to-day that the Canadian outlook, especially in this line, had come to his attention and that he proposed to give the subject investigation. There is quite a furor in the nickel industry at Hamilton, Ont.

MISCELLANEOUS.

Westinghouse, Church, Kerr & Co. have sold to the Solvay Process (soda ash) Company thirty-six Roney mechanical stokers, with economizers and induced draft apparatus. They have sold for installation at the Monongahela furnaces of the National Tube Company 2,000 horsepower of stokers. An order was received to-day from Joseph N. Smith & Co., manufacturers of carriage rails, etc., Detroit, Mich., for an 85 horse-power gas engine.

The Bunnell Telegraph and Electric Supply Company, of this city, has been purchasing an outfit of small tools, of which eighteen or twenty were from the Niles-Bement-Pond Company, including lathes, drill presses, screw machines, milling machines, etc.

The Cleveland City Forge and Iron Company is furnishing to the Glasgow (Scotland) Street Railway Company a shaft 25 feet long, 26 to 37 inches in diameter, and weighing 35 tons.

The Higley Sawing and Drilling Machine Company has additional orders from the Pennsylvania Steel Company, the H. K. Porter Company, Cleveland Steel Castings Company, Peckham Motor Truck and Wheel Company. A new Higley cold saw of the No. 1 pattern has just been installed in the architectural iron works of J. J. Radley & Co., 624 East Nineteenth street.

The Russian Government, we have been informed by the Chicago Pneumatic Tool Company, has decided to equip its navy yards with pneumatic tools. It was closing with that company a contract for 1,000 tools, approximating in value $300,000.

The New York Air Compressor Company, 120 Liberty street, New York, has received an order from the Navy Department for two duplex compound air compressors of large capacity for the Charlestown Navy Yard, Boston, Mass.

The Burt Manufacturing Company, manufacturers of the Cross oil filters, Akron, Ohio, have just received from Yokohama, Japan, one of the largest orders taken so far this year.

A man connected with one of the largest American machine tool concerns pronounces the demand in this vicinity as improving. Speaking of prices, he says that while they are now stationary, he expects to see further advances. This is because manufacturers for a long time were using iron and steel obtained under old contracts at low figures, but now they are feeling more keenly the strength of the material market. Advanced wages, such as are noted in dispatches from the West, he believes, will also have an effect upon machinery prices.

The Berlin Iron Bridge Company, East Berlin, Conn., report having received through a large Philadelphia exporting house the contract for eleven plate girder bridges to be sent to foreign parts. If this order was taken in competition with foreign mills it would seem to illustrate the salvation of American export trade under the handicap of sharply advanced domestic prices through the fact that values have advanced abroad as well. If the business revival of the past two years in this country had not been favored with a contemporary one in Europe our exporters of many lines would have been marooned. Of course, we do not know definitely what were the financial conditions of this order for structural material, nor how important was the factor of individuality in booking it.

CHICAGO MACHINERY TRADE.

With a capacity of production considerably in excess of that of engine manufacturers and with the engine builders sold up well into the future for large work, the boiler makers have a necessarily restricted horizon. So far into the coming months have the engine builders contracted to furnish their output that the lull in new trade which some people look for during the coming summer months does not disconcert them in the least. The period will be bridged over with perfect ease, whatever be the new business forthcoming. The manufacturer who now learns upon inquiry that he cannot obtain the desired power until next autumn pauses and deliberates whether or not he shall proceed with the contemplated improvements or wait a few months. That seems to be the present attitude of Western buyers. The feature of the present market is the relatively large number of inquiries in proportion to the business that is being closed.

There is a vast amount of work in sight, but the word from headquarters to go ahead is withheld in very many instances. Opinion is that little of this prospective improvement will lapse. Delay is the worst that can befall it.

Current trade, however, is by no means dull. There is activity throughout the West, especially notable in the construction of electric street railway, electric lighting, paper mill and other manufacturing plants. Those sellers of power whose field is limited to Chicago and its immediate vicinity have a common comment, the burden of which is that the strikes, present and prospective, are quite trying circumstances, but even here the clouds are breaking somewhat as regards the check to trade that is purely sympathetic in character. Active business men can stay in the dumps just about so long, and after the period expires they will do something by way of trade or know why. In other words, the bugaboo part of the scare is disappearing. Within the past few days there has been an improvement in the small local engine and boiler trade, that was more directly affected by the strike than the broader transactions in those lines.

The Heine Safety Boiler Company has just sold to the Chicago Edison Company four water tube boilers of 574 horse-power each for additional installation in the plant of the company here. Other recent sales of this company include the following: Two 440 horse-power boilers to the Mahoning Valley Railway, Youngstown, Ohio; two 150 horse-power boilers to the St. Joseph Lead Company, Bonne Terre, Mo.; one 500 horse-power boiler to the Philadelphia Smelting and Refining Company, Pueblo, Colo.; two 250 horse-power boilers for the city hall, St. Louis, Mo.; two 333 horse-power boilers for a pumping plant at Crowley, La.

The Erie City Iron Works have sold to the city of Frankfort, Ind., for municipal and commercial lighting purposes two four-valve engines of 200 and 400 horse-power, and tubular boilers of 700 horse-power.

CINCINNATI REPORT.

Cincinnati manufacturers of mining machinery disagree in some important particulars with the views of those in the same line in Chicago. For instance, a manufacturer in this line in the latter city, and one who spoke seemingly for his fellows, said that if it were not for the boom in mining in other portions of the world, the war in South Africa would have been quite a serious blow to mining machinery men. A paragraph to this effect was printed a few days ago in the New York "Tribune's" Hotel Column. This week A. A. Swingley, of the firm of Sheriff & Swingley, mining engineers of Johannesburg, South Africa, placed an order for an air compressor of about 1,500 horse-power capacity with the Lane & Bodley Company for delivery in June, and arranged a letter of credit for something like $18,000 on Brown Bros., New York. Mr. Swingley, in negotiations with President H. M. Lane, estimated that the war would be over in June, and so ordered the compressor for delivery in that month, expecting to begin operations immediately. The machinery ordered is heavy and of a special type. President Lane agrees with the Chicago man in that there will undoubtedly be a big demand directly after the war is known to be over, but disagrees in the statement that there has been any very discernible boom for machinery of this type in other newer portions of the world.

"It is only where the field is thoroughly developed that there is any pronounced demand for machinery of the heavy and costly type," said he. A simple boom generated by the speculators and financiers does not necessarily show its effect in machinery orders; as, for instance, British Columbia.

"Yes, American factories furnish most of the mining machinery used all over the world, and I feel eminently satisfied with our present and future business prospects in this line. Coming back to the Johannesburg mines, the Boers and the war, most people lose sight of the fact that it is not the British that control the mines; they are all practically all managed by the Germans, as the mining interests are predominatingly German."

Manager W. F. Hays, of the Cincinnati department of the General Electric Company, notes an exceedingly great number of what promise to be very important projects in street railway construction and equipment for power plants. He anticipates the beginning of active work on a large number of electric railway systems within a very few weeks, and says the Cincinnati house has orders for supplies ten months ahead. A good-sized order was received during the week for equipment for twenty-six new cars just built for the Louisville Street Railway Company. Delivery of this material will be made in about two months.

J. T. Rader, president of the National Shear Company, is here in the interests of his company and also to sound local manufacturers on the feasibility of an association of all the shear manufacturers of the United States. Mr. Rader reports business in this line unprecedented in the history of the industry. He has visited practically all the Western machine and machine tool making plants, and says a large-sized boom is on everywhere, particularly in the iron trades.

Max Touret, an electrical engineer of Paris, France, representing the "Société l'Electra" of that city, is another visitor in the machinery marts of Cincinnati. M. Touret is posting himself in electrical engineering generally and examining into the intricacies of advanced electrical machinery making. He spent a day or so going through the big Norwood plant of the Bullock Electric Manufacturing Company. He is delighted with what he has seen in this country, and says such machinery is made much better and cheaper than in his own. The street cars of France, says M. Touret, are many of them equipped with motors made in this country. Speaking of the Exposition, the visitor says he believes the gates will be thrown open on the date advertised, and that everything will be in readiness.

The E. A. Kinsey Company, one of the largest jobbing firms here in all kinds of machinery and machine tools, says that buying is liberal in all lines and that the department of railroad supplies shows a particular expansion.

"There are now thirty-five plants in Cincinnati devoted to the manufacture of machine tools," said the manager of one of the departments of this house, "and that they are all running full and over time and enlarging shows something of what the year is likely to develop in this industry. As to prices, while in certain lines there is a little weakness or falling off since the first of the year, in the main they are keeping up, with an outlook for a stronger market.

Quotations.

NEW YORK, Monday, March 12, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:	
No. 1 X foundry	$23 45 @ $23 70
No. 2 X foundry	22 45 @ 22 70
No. 2 plain	20 70 @ 21 45
Alabama Irons:	
No. 1 foundry	22 25 @ 22 75
No. 2 foundry	21 25 @ 21 75
No. 3 foundry	20 25 @ 20 75
No. 1 soft	22 25 @ 22 75
No. 2 soft	21 25 @ 21 75
Foundry forge	19 75 @ 20 25

Bar Iron — Base sizes — Refined, mill price on dock, 2.10 @ 2.25c.; store price, 2.45 @ 2.60c.; common from store, 2.40 @ 2.50c.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—Ordinary brands from store, 2.85 @ 3c.

Cold Rolled Steel Shafting—Base sizes—From store, 4 @ 4.25c.

Copper—Lake Superior ingot, 16½c.; electrolytic, 16⅜ @ 16½c.; casting copper, 16¼ @ 16⅜c.

Pig Lead—Wholesale lots, 4.70c., New York delivery; carloads, 4.72½ @ 4.75c.

Pig Tin—In 5 and 10-ton lots, f. o. b., New York, 34 @ 34½c.

Spelter—Prime Western, 4.65 @ 4.70c., New York delivery.

Antimony—Cookson's, 11 @ 11¼c.; Hallett's, 9¾c.

Lard Oil—Prime City, present make, 50 @ 53c., according to brand and quantity, in jobbing lots.

Multiple Spindle Drill Work—II.

BY D. E. MAC CARTHY.

In my first letter on the above subject reference was made to holding work securely, by the drills, after the cut had started. The practicability of this method will be illustrated by the sketches of four fixtures (designed and now in operation) for drilling all holes in the cast-iron box, shown in the photograph, Fig. 1. The box is cast in four sections, the two sides *X X* with a removable panel in each, and the front and back plates *Y Y* are held in place by screws at *A B C D*.

Fig. 2 shows three views of the first fixture, for drilling holes *A B C D* in the lugs on side castings *X X*. It consists of a base-plate *a*, top plate *b*, crossbar *c* and two side standards *d* and *e*. A thin steel plate *g* is fastened to the base-plate as a guide for the thin edge of the casting, the top plate *b* acting as a guide for the other edge.

The drill spindles are set with drills through the bushings in the top plate; the jig secured to the drill table by bolts at *f f f f*.

The fixture is raised from the table by feet, to allow clearance for the casting feet above the drill table. Top plate *b* is set high enough to permit the free entrance of casting *X*, and the spring pins in side standards *d* and *e* give sufficient pressure to support the casting, still allowing free movement in setting.

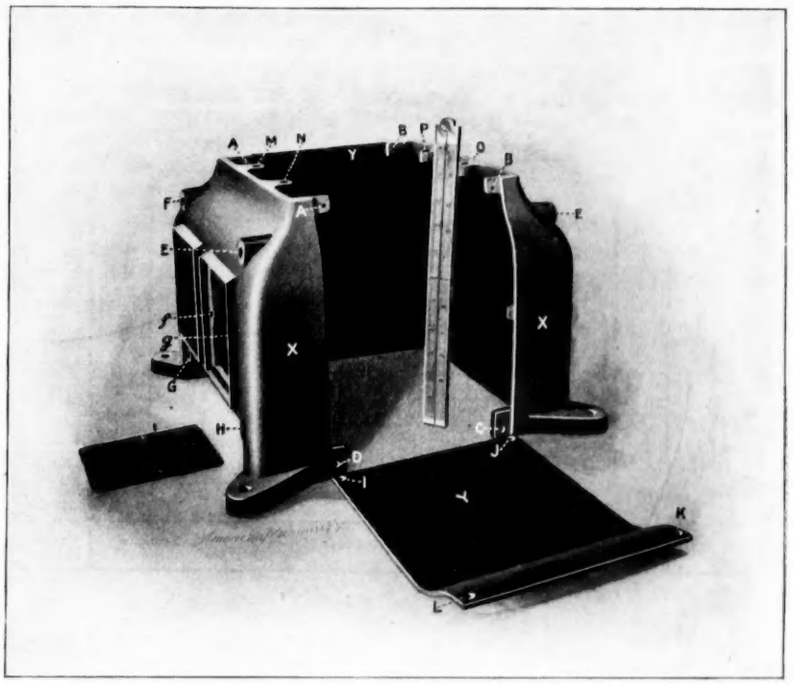


FIG. 1. MULTIPLE SPINDLE DRILL WORK. THE WORK TO BE DRILLED.

When starting to drill with this fixture, a casting is slipped in on the left side only, and drilled, taken out, turned over, put in on the right-hand side, and another casting placed on the left; then four holes are drilled, and the right-hand casting can be removed finished, the left-hand one taken out and replaced in the right-hand side. Continuing in this manner, one casting is coming from the fixture finished at each drilling, which also permits the operator to handle but one casting from the floor at a time.

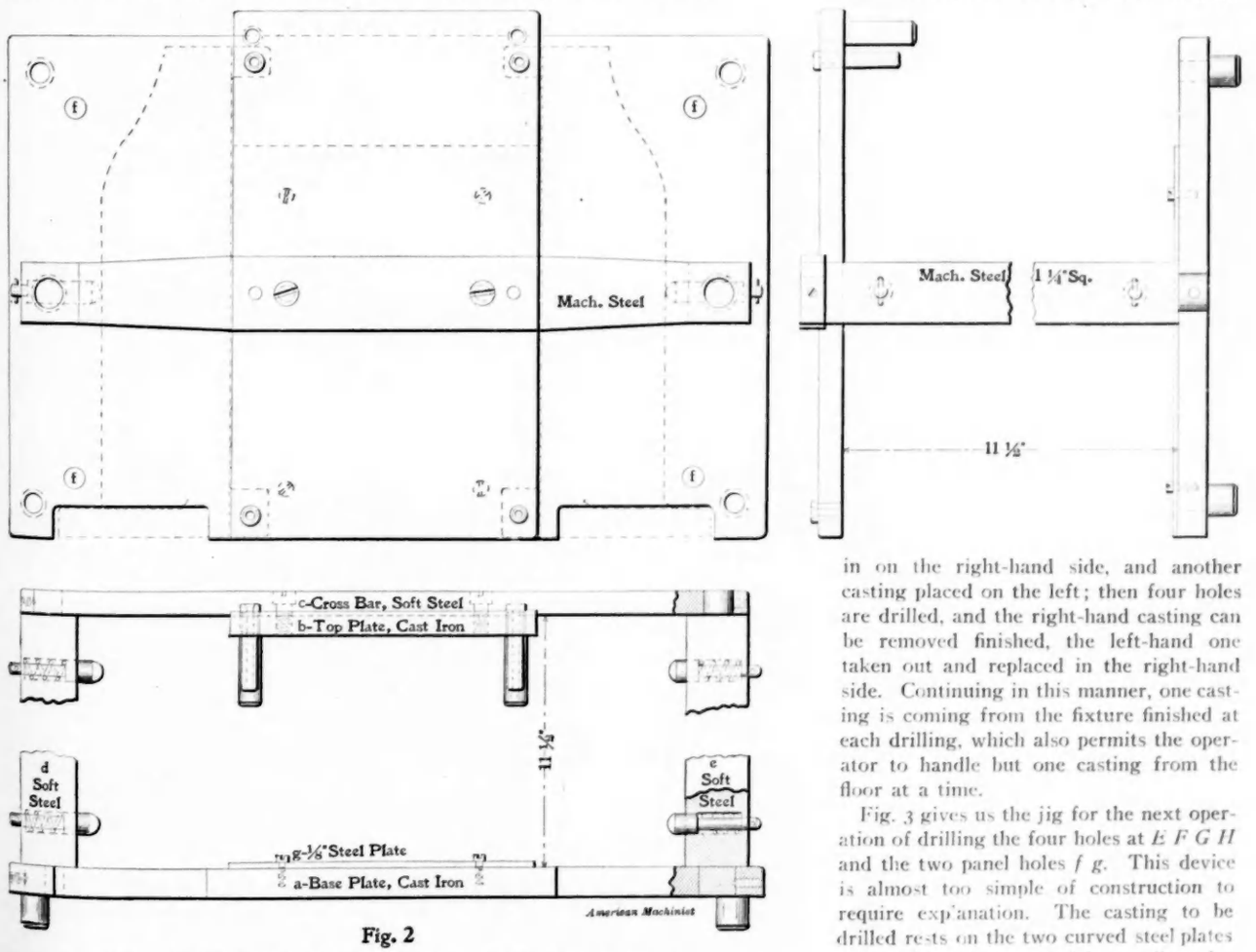


Fig. 2

MULTIPLE SPINDLE DRILL WORK—FIXTURE FOR FIRST OPERATION.

Fig. 3 gives us the jig for the next operation of drilling the four holes at *E F G H* and the two panel holes *f g*. This device is almost too simple of construction to require explanation. The casting to be drilled rests on the two curved steel plates *a b*, which are supported by small angle-

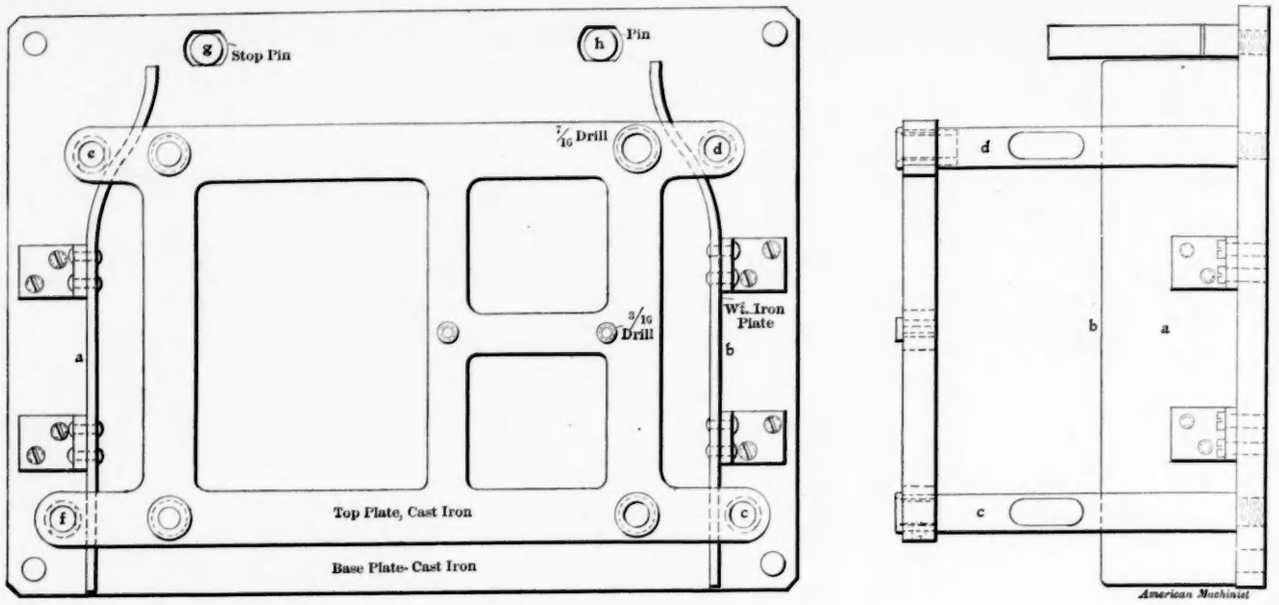


Fig. 3

MULTIPLE SPINDLE DRILL WORK—FIXTURE FOR SECOND OPERATION.

irons attached to the base-piece. The top plate (of cast iron) holding the bushings is supported from the base by four long studs *c d e f*, which screw in tight at the bottom, and the top plate is pressed on. The fixture is bolted to the drill table, same as the first one, and the casting to be drilled is slipped in against the stop-pins *g h* and held in place by hand until the cut starts; no bolts or clamps of any sort are required, which allows very rapid handling of casts.

The fixture for the third operation—that of drilling the front and back plates *Y Y*, and shown in Fig. 4—is made with a cast-iron plate and four soft-steel angle-pieces holding the bushings and guiding the piece at the sides. The dotted lines represent the casting in place to be drilled. The last drilling operation is done after the four sections of the box are put together; Fig. 5 showing by dotted lines the box placed in the fixture, under the drill bushings, for drilling the four ¼-inch holes on the top *M N O P* and the four feet at the base of the casting.

The bushings for the feet holes are held by steel angle-pieces, which also perform the duty of guides at *c d e f* for the sides of casting. The fact that the four lower holes are about 10 inches below the top of the box requires extension sockets to bring the drills for the lower holes in touch with the work at the same time as the cut starts on the four top holes. The time required for drilling the eight holes of the last operation is thirty-five seconds, with thirty seconds added for handling the box.

It will be noticed that all these fixtures are made light and simple of construction; in fact, the labor is of the plainest sort—nearly all straight work of cast-iron plates and soft-steel studs, with a few hardened pins of tool steel for stops. If jigs were demanded for drilling each hole separately (which would call for the turning over and moving around of the fixture), much more expensive design would be required as well as the handling of quite a bulky and cumbersome affair.

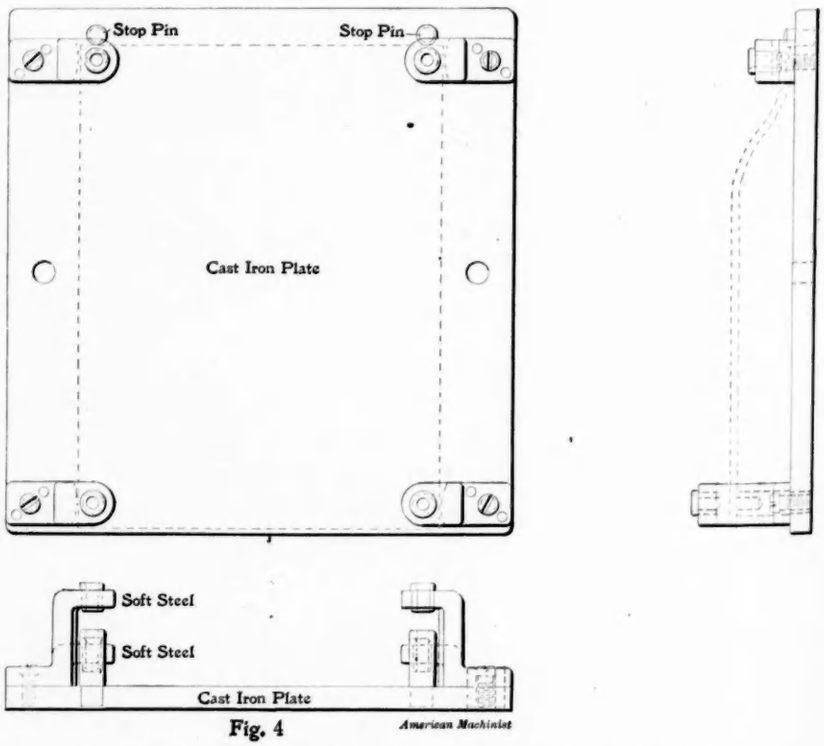


Fig. 4

MULTIPLE SPINDLE DRILL WORK—FIXTURE FOR THIRD OPERATION.

In Siam 830 tamarind seeds make 1 "k'anahn," 25 "k'anahn" make 1 "eat," or bamboo basket, and 80 "eat" make 1 "kwein," or cart. Finer measurement, no doubt, than "three barleycorns make one inch."

Municipal Kerosene.

When once you start to paternalize or municipalize industries, it is difficult to tell where to stop. There are so many things a government can do badly that it hardly seems fair to make invidious distinctions in picking out opportunities for extravagent employment of the taxpayer's money; and this is the sentiment which pervades the breast of every true socialist. Last week Dr. Maltbie, when addressing an audience in this city on the beauties of English municipal ownership, struck such

a condition of mind in his audience. One gray-haired man arose and asked the Doctor whether or not kerosene oil should be sold by the city governments. "I burn kerosene," he said, "because I can't afford gas. If the municipal ownership of gas is right, the municipal ownership of kerosene is right, too." Thereupon burst forth a dispute as to what socialists do or do not believe in, but that aside, our kerosene friend seems to have right on his side—granting the postulate that a city or State government ought to venture into business at all. In fact, he does not go far enough. A good many people in this country burn candles, and somehow it doesn't seem quite right not to have municipal candle-shops as well as municipal electric-light plants.—From "Electrical World and Engineer."

"Granting the postulate" that a trade journal should discuss these matters, then it follows that it should do so candidly and with a full recognition of the conditions; else its arguments, even though they be on the right side, can do no good. The making and selling of kerosene and candles involve no exclusive or special use of city streets. No franchise has to be purchased or stolen in order to carry on these lines of business. Herein is the vital difference between kerosene and electric lights, gas, water, etc., and those of us who are not socialists or in sympathy with the socialist philosophy ought to be all the better able to recognize this difference, and if we discuss these matters without such recognition we probably help socialism rather than harm it. It is undeniable that human experience all over the world has shown that to grant to individuals or private companies unlimited franchises or special privileges to use city streets, has tended strongly toward municipal corruption, and that the rights of citizens have not been safeguarded by it. To say that those who perceive this evil and seek a way to avoid it are all socialists is begging the question, and is, moreover, generally untrue.

Straight Line Motions.*

The straight-line motions which have been invented at different times may be roughly divided into three classes—those in which the motion is exactly rectilinear, and in which no other straight line is required for a guide; those in which the motion is exactly rectilinear, if we may be permitted to use one or more straight lines to guide certain parts of the mechanism, and those in which the rectilinear motion is only approximated.

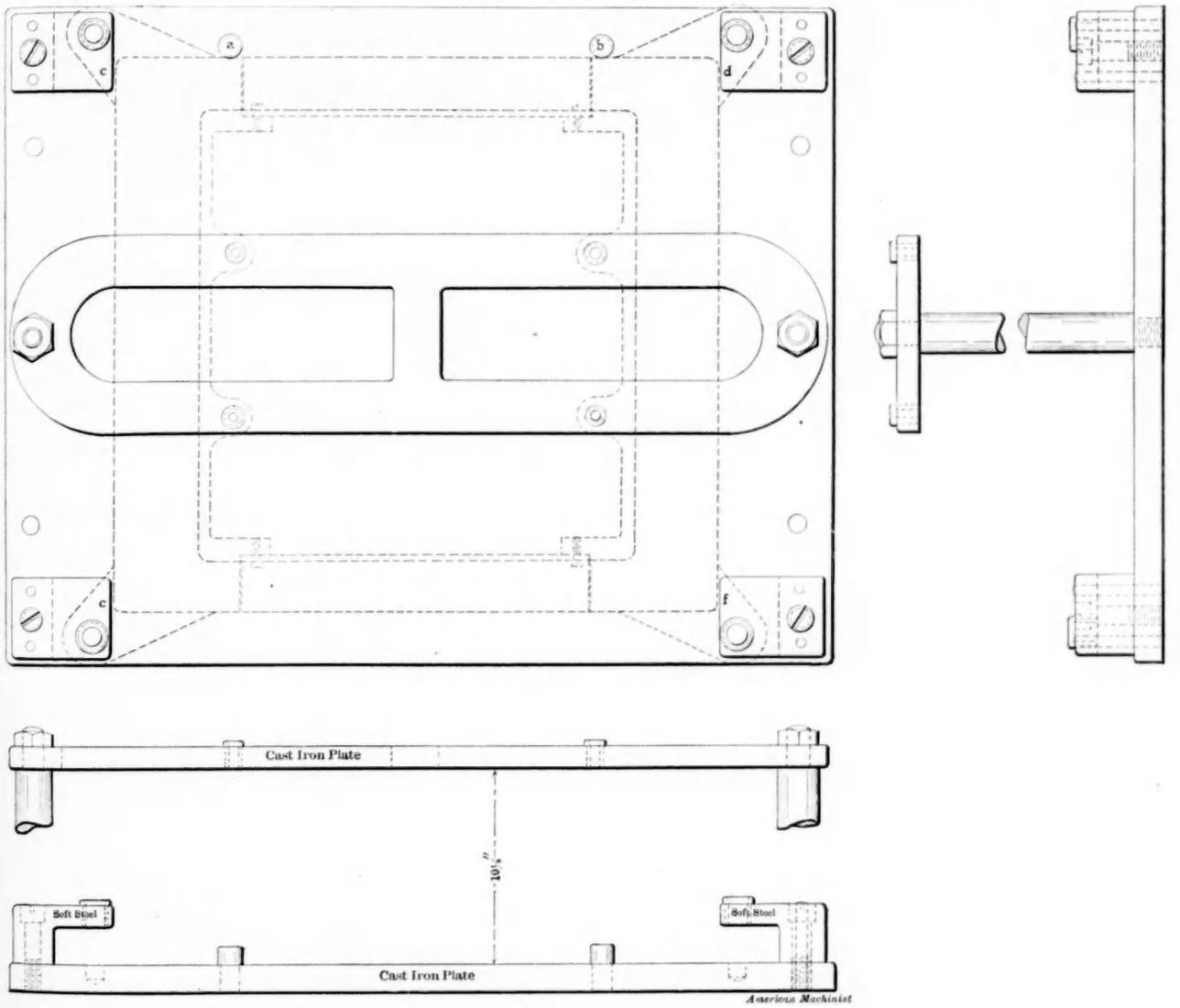


Fig. 5

FIXTURE FOR MULTIPLE SPINDLE DRILL WORK—FOURTH OPERATION.

One of the oldest motions is that produced by the Cardan circles. These circles are shown in Fig. 1, where the smaller one is half the diameter of the larger, and rolls on the inside of its circumference. Then any point on the circumference of the smaller circle will travel on a straight line, which is a diameter of the larger one.

In practice, to avoid slipping, and to make the motion positive, the circles might be replaced by an internal gear and a

* From a paper by Prof. John B. Peddle in "The Rose Technic."

pinion, the center of the latter being constrained to move in a circle by a link from the center of the large gear. The point P would be located on the pitch circle of the pinion.

Cartwright's motion consists of two spur gears in mesh, to which are pinned two links, as shown in Fig. 2. If the pins move on circles of equal radius, and the gears are so meshed that the pins are always equally distant from the center line $C P$, and if the links are of equal length and joined at P, the point P must travel on the straight line $C P$.

In Fig. 3, suppose $H P$ to represent a straight line perpendicular to $A H$. Draw any line $A P$ through A and intersecting $H P$ in P. Also draw a circle with its center on $A H$ and with A on its circumference. Connect C and G, the points where $A P$ and $A H$ cut the circle. We then have two similar triangles, $A H P$ and $A C G$, and

$$\frac{HA}{AC} = \frac{AP}{AG} \therefore HA.AG = AC.AP$$

or the product of $A P . A C$ is constant.

The Peaucellier cell consists of seven movable links, joined as shown in Fig. 4, and attached at A and B to a fixed link. If $C D$, $D P$, $P E$ and $E C$ are equal and also $A E$ and $A D$, then A, C and P always lie upon the same straight line. Make $A B$ equal to $B C$, and find the intersection F of the lines $E D$ and $C P$. Then

$$E F^2 = A E^2 - A F^2 = E C^2 - C F^2$$
$$A E^2 - E C^2 = A F^2 - C F^2 = (A F + C F)\ (A F - C F),$$

or $A E^2 - E C$ (a constant) $= A P . A C$.

The application to Fig. 3, in which the same letters are used for the same points, will be apparent at a glance, and we see that P must move on a straight line perpendicular to $A B$.

Suppose we have any quadrilateral $A B C D$, Fig. 5. Let us take a second quadrilateral, Fig. 6, to the first and with the lengths of its sides in the ratio k to the corresponding sides of the original figure. Let the corresponding points in the new figure have the same letters as were used in the first, but primed. Now, if we suppose the original quadrilateral to be formed of four bars connected by turning pairs at A, B, C and D, and the second quadrilateral to be formed with the first by the addition of two more bars pivoted to $A B$ and $A D$ at D^1 and B^1 and to each other at C^1, and if we further suppose $A B$ to be a fixed line, we have a mechanism which is completely constrained, as each of the component links will have a certain definite movement if either one of them is displaced.

Let us add two more links $P O$ and $P^1 O$ equal respectively to $P B$ and $P^1 D^1$ and join them to O. We then have two isosceles triangles $P O B$ and $P^1 O D^1$ and an inspection will show that since B and D^1 are fixed and the horizontal distance between P and P^1 is constant and equal to $\frac{B O^1}{2}$ O must lie on $B D^1$ for all positions of the mechanism, or will trace a straight line.

Let us now turn to the second class of motions referred to at the beginning, that in which a straight-line guide is required for some portion of the mechanism.

These motions will, in general, depend upon the principle of the Cardan circles. If the smaller circle rolls inside the larger one, any point P will trace a diameter of the larger circle. Likewise any other point P^1 will trace some other diameter. If now we suppose the outer circle to be removed and the points P and P^1 guided upon the straight lines $O P$ and $O P^1$, the smaller circle will have precisely the same motion as when it rolled within the larger one, and its center C will travel on a circle about O as a center. Now, suppose that O and C are connected by a link, so that C is constrained to travel on a circle of $O C$ radius, and suppose point P to be constrained to move along a straight line $O P$, while P^1 is free. It will be seen that P^1 necessarily moves in a straight line $O P^1$.

P and P^1 may be connected by a bar of any form, and C may or may not be on the straight line connecting P and P^1, as $O P$ and $O P^1$ do or do not meet at a right angle.

Any third point on the circumference of the smaller circle, such as P^{11} will also move on a straight line, and if we again suppose that the outer circle is removed and the inner one constrained only by the points P and P^1 which are to move on $O P$ and $O P^1$, P^{11} still has a rectilinear motion along $O P^{11}$.

A skeleton diagram of such a mechanism is shown in Fig. 8.

When we come to the third class of linkages we find a bewildering variety of forms, but upon analysis it will be found that most of them fall into one of three subdivisions, which involve in some way one of the three mathematical curves—the ellipse, the lemniscoid and the conchoid.

Taking them up in order, we find the Cardan circles again made use of in the first division.

If, instead of taking a point on the circumference of the inner circle, we take it either outside or inside of the circumference, we will find its path to be an ellipse.

In Fig. 9, let points P and B move on the straight lines $P P^{11}$ and $B C$, then the path of A, taken anywhere on $P B$, will be an ellipse, and if the movement of P is not too great we can find a circular arc

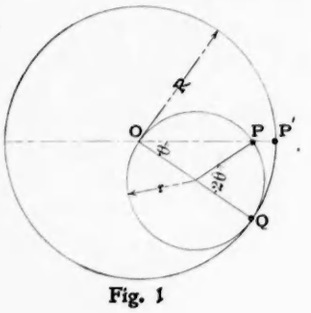


Fig. 1

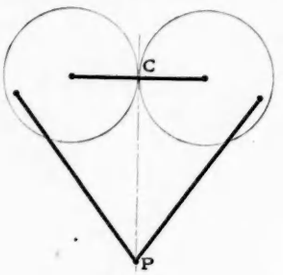


Fig. 2

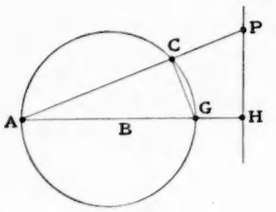


Fig. 3

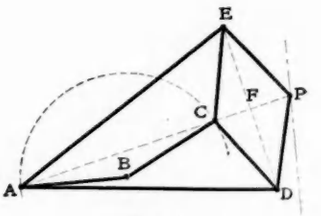


Fig. 4

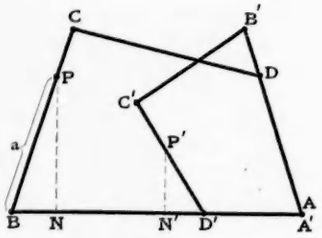


Fig. 5

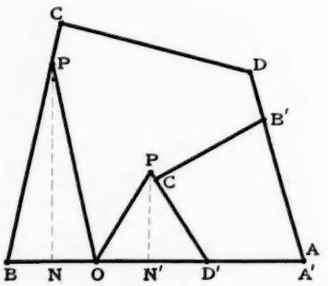


Fig. 6

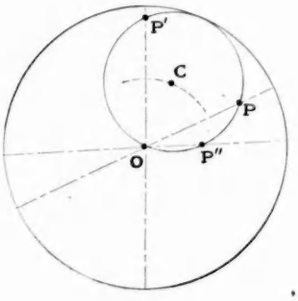


Fig. 7

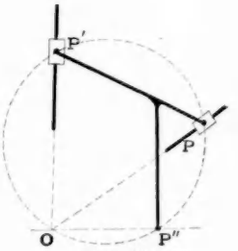


Fig. 8

STRAIGHT LINE MOTIONS.

closely approximating the elliptical arc. If, therefore, we constrain A by the link $A C$ and give a rectilinear motion on $B C$, P will move on a line which is approximately straight. This mechanism has the constructive advantage that P's path does not pass through C, a matter of considerable importance in some cases.

In designing a linkage of this description, $P B$ should be drawn for the highest, middle and lowest positions of P, and the corresponding positions of A located. The center of an arc passing through these points is C.

It is evident that if, in Fig. 9, A is taken at the middle of $B P$ its path becomes a circle with center at P^1, and we have one of the exact forms spoken of in class two. It is known as Scott Russell's motion.

If P does not move very far on either side of the center line $B C$, the motion of B will be small and the straight-line guide may be replaced for most practical purposes by a link which will cause B to move on the arc of a circle.

This movement, more or less disguised, appears in many indicator motions.

Two of the best known motions depending on this idea of approximate elliptical arcs are the Roberts and Tchebicheff linkages.

In the first, we have a quadrilateral linkage $A B C D$ in which $A B$ is fixed. P, the straight-line point, lies on an extension from $D C$. $A D$ and $B C$ guide points D and C on arcs which approximate ellipses, and P is supposed to be on the circumference of the equivalent Cardan circle. When P falls on $A B$, $D C$ is half of $A B$ and $A D = D P = C P = C B$.

The Tchebicheff motion is illustrated in Fig. 12, where $A B$ is a fixed link, and P, in the middle of $C D$, is the describing point. Here, too C and D are given motions which approximate ellipses.

The various modifications of this ellipse idea may be multiplied almost indefinitely, and Reuleaux shows a great many of them "inverted"—that is, the point which we have seen move in a straight line he makes stationary, and allows the former fixed points to move. Since their relative motion is the same in either case, we must again have a rectilinear motion.

In Fig. 9, for instance, suppose P to be fixed, and allow the link $B C$ to move up and down. Some means must be provided to keep $B C$ always parallel to its initial direction. This can be done, among other ways, by means of the sliding-turning pair at D (on the fixed link $P D$) acting on the extension bar $D E$, Fig. 13.

In such a case any point on the link $B C$ will travel in an approximately straight line. In practice the extension bar $D E$ would be the piston rod of a steam engine or pump, and the sliding pair at D would be the stuffing box.

Passing now to the lemniscoid linkages, the most famous is Watt's so-called "parallel motion." He used it quite extensively in his engine practice, and even now one occasionally runs across it in the older beam engines.

It consists of three movable links, pivoted, as shown in Fig. 14, to the fixed points A and D. A point on $A C$ will trace a lemniscoid or sort of distorted figure 8. Part of the path under favorable conditions is very nearly straight, and this is used for straight-line motion. The best results are obtained when $A B$ equals $D C$, and when at midstroke they are parallel to each other and perpendicular to the path of P. P will then be in the middle of $B C$.

In practice the piston rod would be attached to P, and $A B$ would be the beam of the engine. In this form, however, it would require a considerable extension of the engine bed to include the fixed point D, and we generally find the mechanism modified as shown in the dotted lines, where $A B$ is extended to, say, E, and the links $E F$ and $F G$ added to form the parallelogram $E F G B$. This evidently forms an enlarging pantagraph, and by finding the intersection of a line through A and P with one of these added links (in this case F) we get a point which exactly reproduces the motion of P on a larger scale, and to which, therefore, the piston rod may be attached.

This last of the linkage forms which I referred to above was that which involved the conchoid.

The conchoid is a curve traced by a point on a straight line which constantly passes through a fixed point called the pole, and which moves so that a given point on it is always on a second straight line.

In the figure D is the pole and P moves along the straight line. Then A, B and C each trace a conchoid. It is easily seen that if P does not move very far from its mid position the arcs traced by A, B and C may be represented approximately by the circular arcs, the centers of which may be readily located as in Fig. 9. By using links, then, to guide any of these points in a circular arc we are able to give P a motion which is approximately rectilinear.

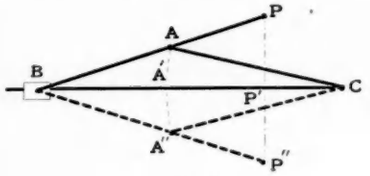


Fig. 9

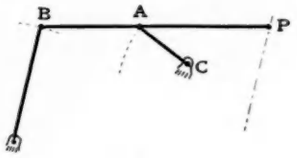


Fig. 10

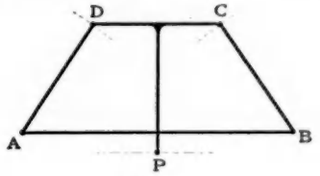


Fig. 11

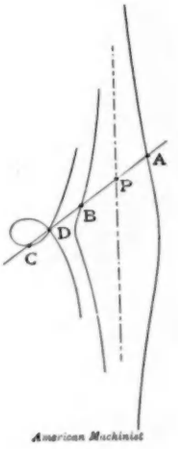


Fig. 15

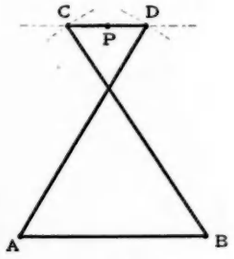


Fig. 12

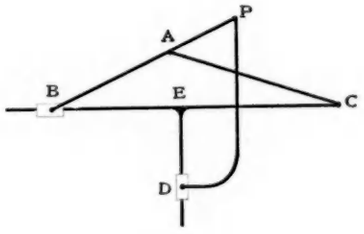


Fig. 13

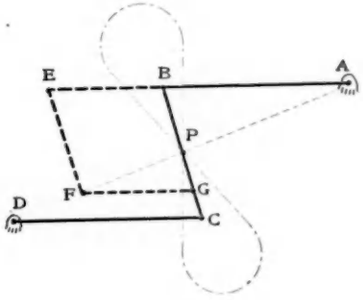


Fig. 14

STRAIGHT LINE MOTIONS.

Economy of Electric Light Plants.

Old farmer to his son: "Now, don't fergit while ye're in the city to git some uv them 'lectric light plants we heern so much about. We kin jis' ez well raise 'em ourselves an' save kerosene."—"Woman's Journal."

An experiment in co-operative industry was made at Cincinnati in the establishment, last July, of The Rapid Electrotype Foundry on the co-operative plan by members of the electrotypers' union of that city. Apparently the enterprise is proving a success, for the company is now installing $2,500 worth of machinery, and it is not improbable that the capital stock will be increased from $12,000 to $20,000.

A Casting With a Troublesome Core.

BY R. H. PALMER.

Fig. 1 shows a casting known as a drying machine column, and it is a casting that every once in a while there is trouble with. The casting has two sides, some 1¼ inches thick, and running through the center from end to end is a pipe *D* having outlets through the sides, as *E*, while the main pipe *D* is also connecte' with the sides by ties, as *F*, leaving open spaces between the pipe and the sides, as *H*. Fig. 2 shows the pattern, with core-prints. A great many of these castings were made, but sometimes the cores would blow. The main core running lengthways was made in two pieces, butted together in the mold at T, Fig. 4, while vent was taken from opposite ends at points *L*, Fig. 4. The cores ranged from 2¼ inches in diameter upwards for the different sizes, and would be up to some 14 feet in length, and it was for this reason they were made in two sections or pieces.

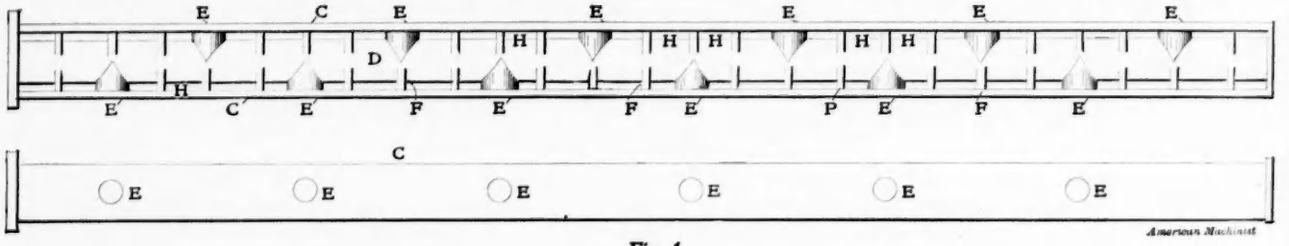


Fig. 1

THE CASTING TO BE MADE.

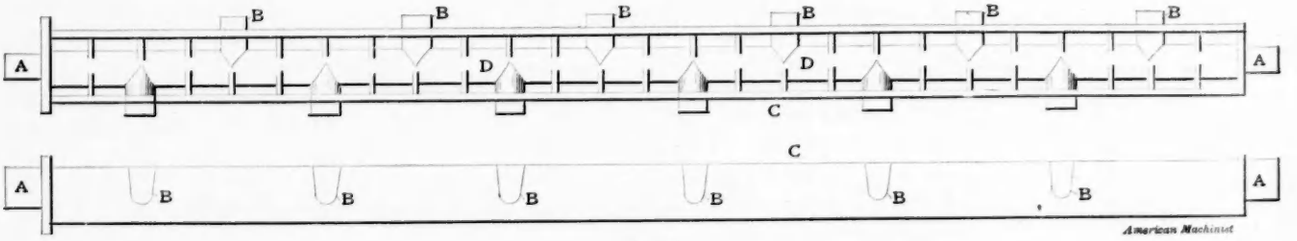


Fig. 2

THE PATTERN.

After the mold was made and finished, the center cores *N*, Fig. 4, were set resting on chaplets *C*, and one end in print *W*. A rod was introduced through a hole in the end of the flask at *L* to connect with vent outlet in end of core, and this end of the core was stopped over with some sand and the rod withdrawn. Next, the cores to form the side outlets were placed in prints *B*, but each resting on a nail for a chaplet, and the ends of these cores hollowed to fit the circle of the center core and forced tight against it, and the ends resting in prints *B* stopped over. In Fig. 4 the right-hand end of the flask will be seen cut away, showing the pattern, we will say, *X X*, and beyond it the thickness of wall of pipe will be at *M* and the core at *N*.

Supposing the drag finished and the cores set, also the cope finished, chaplets *D* are now shoved through the cope, also nails set over the branch cores. The cope is now tried on and taken off. As there are so many of those small pockets *H*, Fig. 7, some will be found to bear too hard.

The chaplets used are tinned, as experience shows that tinned chaplets give the best results where steam is to be used, and this pipe is to stand steam pressure.

The cope being closed on for good, iron binders made for the purpose, shown at *O*, Fig. 3, and *D*, Fig. 4, are laid across over the chaplets. Clamps *R* are placed catching on top of these binders, and wedges *K* shoved under and tightened in between.

Runner boxes are nailed on to the flask, and the runners are partly built before the cope is taken off; but the gate-sticks are not removed until the cope is closed on for good, and then the runners are ready; but the run-offs at *F* are built after closing. Wedges of iron are shoved between binder *O*, over the heads of the chaplets *D*.

Now for the thing that causes more loss and trouble than the whole mold, and that requires care in making as well as the mold—the cores.

Every once in a while a casting would be no good. It would be poured and flowed through, and then we would stand and wait to see if the iron was going to lie still. I have seen one lie perfectly quiet, and have started the ladle back to the cupola, when there would come a pop, and out the iron would fly from the gate.

Going into the core-room one day, I saw one-half of one of these cores lying there with a vent scratched in it running like *A*, Fig. 5. I passed on, only touching it with a piece of chalk; but I was looking for that core when they were brought down, and I had the wires removed and the core in two on the facing. It was found that the channelway at point *X* was stopped with paste. The channelway was scratched in the center, the core repaired, dried and set, and the casting was all right.

In a core of this kind, with the amount of iron surrounding it, it needs as large a vent channel as can safely be given to allow of as quick an escape of gas as possible. I may be wrong, but I always figured that its being poured on the ends, the gas, starting from the farther end, was being expanded by the core getting hot as it approached the outlet; and by having a vent shaped like the one in *B*, growing larger as it advanced toward the outlet, I was providing for it to escape, and allowing what I could for expansion, as, judging by the way the iron acted in pouring, it seemed to me, when there was trouble, that the core became so hot, and the vent channel was so small, the gas becoming choked in these, and the heat expanding, it burst the core apart; as in every such case the casting would be found with a partition of iron either through it, or indications of such being the case.

In a case like the above I blame the coremaker for not providing a proper-sized vent channel and properly pasting the core. But I cannot help feeling that many times a coremaker is unjustly blamed by an unthinking molder.

In foundry management oftentimes a class of help is hired and put to work in the core-room making cores, that is in every sense of the word "cheap" help. It is the cheapest that can be hired, because it has been thought that because a certain class of cores are easily made, all are so. The saving of money is what is saved between the price of a poor boy and a good man.

The effect on the actual production of castings for market is lost sight of, or its importance is dwarfed by the difference in figures on a pay-day envelope; although many a foundry owner would resent any such insinuation, and inform anyone that he always employs the best help he can get; and so he does—for what he wishes to pay.

The Education of Machinists and Mechanical Engineers.

The following communication, which we reproduce from the columns of "The Railroad Gazette," voices some truths which we have repeatedly presented in our columns. Not the least gratifying portion of this letter is its recognition of the work of the mechanic in developing our machine tools and shop methods:

"My attention has been called to the interesting article in your issue of January 19, signed 'W.,' commenting upon my paper on the 'Training of Machinists, Foremen and Mechanical Engineers.' In reference to this paper two subjects are emphasized by the writer of that article which I may be able to make clearer, and upon which my own position may be more clearly defined. The first is regarding the educational success of the training at the Worcester Polytechnic Institute, as well as the financial consideration. The second subject relates to the comparative skill required of the machinist of to-day and the machinist of thirty or forty years ago.

"It is well known that the limits of a professional paper presented at a meeting of a society like that of the American Society of Mechanical Engineers forbids the treatment of all sides of such a subject as that under discussion. Moreover, the educational value and success of American technical schools is well understood, while the difficulties and the value of conducting commercially productive shops as a part of such training is not so generally acknowledged.

"The Worcester school was one of the first which, from the beginning, has published from year to year the name of every graduate, together with his occupation. That list is still published as a part of the annual catalog, which will be sent to anyone making application. The statement of these facts regarding 782 graduates from 1871 to 1898 exhibits a remarkable class of efficient and successful young men effectively engaged in all sorts of responsible positions in the manufacturing and mechanical industries throughout the country. I think the graduates of the Worcester school stand high in theoretical and scientific attainments in comparison with those of other engineering schools, and in addition, the graduates in mechanical engineering have the advantage of a more thorough and more practical shop training than any other school has attempted to give.

"Comparing the graduates of the Worcester with those of other technical schools, my observations lead me to the belief that they more promptly secure lucrative and responsible positions, that there is among them a smaller percentage of failures, that in ultimate attainments they stand fully at par, this notwithstanding their course was one of three and one-half instead of four years. I attribute these results largely to the commercial feature of their education.

"Regarding the need of skilled machinists and the importance of suitable foremen, 'W.' says: 'In the future the position of foreman should be a less difficult one to fill.' And in the discussion of the paper when presented in New York the following remark was made: 'I do not believe that the manual skill required of the machinist to-day is as high as that of thirty years ago.' The criticism was made in this case by a college professor.

"We shall certainly suffer great loss if we are allowed to be led into any such error as this. Automatic machinery, systems of piece-work and divisions of labor do not and will not lower the requirements of the machinist's skill and knowledge. Although these changes enable the manufacturer to make a larger use of unskilled laborers as operatives, yet, on the other hand, the requirements for skill of the machinist have been raised, not lowered. He must think more accurately, make more exact measurements, work hardened steel parts to a degree of precision that was not thought of by the old-time machinist. The skill and scientific knowledge regarding cutting tools and tempering many kinds of tools and parts of machinery have made very wonderful advances within our memory. Take, for instance, a single tool illustration, the die for thread cutting. The old tool was properly called a "jam plate." The screw thread was made by jamming the metal into the form of a thread. There was not then knowledge enough in the shops to lead to the conception of chasing a clean full thread with a single cut with the die and removing free continuously cut chips from the iron or steel. Such attempts were then gradually confined to jamming a poor thread on a small bolt by repeated passes. Now we see practically perfectly full, clean threads cut on rods of any length up to 2 inches or more in diameter. This wonderful achievement is entirely due to the advanced skill and understanding of the machinist and mechanical engineer, who was a machinist before he was an engineer.

"We must not be misled by the observation of automatic machinery turning out the most exact work with such rapidity when operated by a rough boy called in from the streets or from the farm. In addition to the superior skill required of the machinist to construct these automatic machines, we should remember that it is not safe to run them a single day without

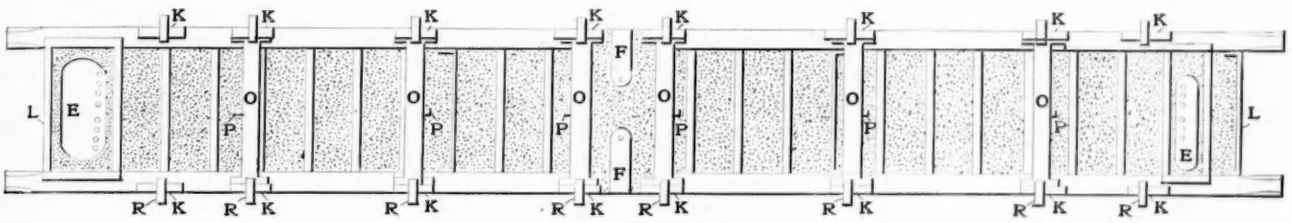


FIG. 3. TOP OF MOLD.

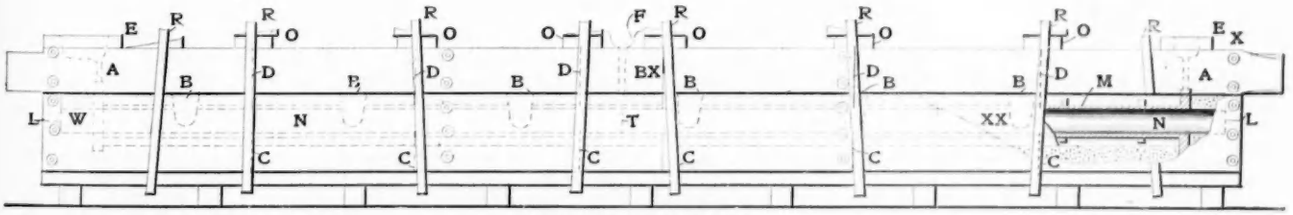


FIG. 4. SIDE OF MOLD.

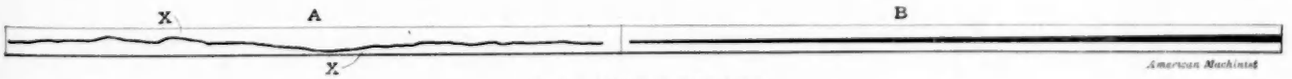


FIG. 5. VENTING THE CORE.

the presence of a skilled machinist, who may be called upon to make an adjustment, to detect a mysterious fault in its action, to adopt a new form of product, or to refit or make a new member requiring exactness and an accuracy of measurement that would have been impossible to the ordinary machinist of thirty years ago. I am of the opinion that if all our present improved automatic machinery and refined shop instruments and machine tools could have been delivered and set up in the machine shops of thirty years ago, there would not then have been skill enough to have made use of them.

"Thus the use of automatic machinery, so marvelous in extent and accomplishment, may lead one to a false conclusion regarding the requirements for our future machinists. The field of the machinist has broadened so greatly that he does not find himself replaced as the newspaper compositor is replaced by the linotype operator, but he is called upon to construct hundreds of new machines to make new products. If an automatic bolt cutter, for example, relieves him of a portion of his former duty, he is still needed in making the machines that are replacing hand labor in other trades. He is making automatic shoe machinery, automatic type-setting machinery, automatic sewing machines, automobiles and hundreds of machines used to fill wants not known or felt fifty years ago. He is replacing the skill in the other arts and manufactures by his own skill.

"Such is the superior skill required of the machinist of to-day, in order to keep our highly organized machines working properly, that the training of machinists becomes of the greatest moment in the question of national mechanical supremacy. While France, Switzerland and Germany are giving such splendid training in development of skill among all classes of their mechanics below the mechanical engineer, we cannot fall into greater danger than that of feeling secure and confident that automatic machinery, shop systems or what not will take the place of mechanical skill and scientific shop training of our machinists. And we must not forget that the perfection of our machine tools and of our small tools and of our automatic machinery have been evolved, invented, made, improved and perfected by machinists rather than by any other class of men in the line of mechanical industry. Furthermore, this high development is the direct result of the personal observation and experience of skilled machinists in the actual performance of work by the old and poorer methods. Through their daily experience they felt the need and met it.

"Just as soon as the American mechanic sits down to smoke complacently because he has an automatic machine which is kept going by a thoughtless operative, just so sure will he find himself behind in the race for mechanical supremacy.

"MILTON P. HIGGINS."

Switchboard Instruments—Ammeters and Voltmeters—II.

BY WM. BAXTER, JR.

Of the types of instruments illustrated in Figs. 1 to 11 those most commonly employed by manufacturers are Figs. 2, 3, 6, 7, 8 and 9. One of the instruments constructed upon the principle of Fig. 6 is the Wirt. This instrument, like those of all other makes, is made either as an ammeter or a voltmeter. For both kinds of instruments the mechanism is the same, the only part that is changed being the wire coil, which for ammeters consists of a few turns, and for the voltmeters of several thousand turns. Voltmeters usually have a second pointer, which is stationary, except as set by hand, to indicate the standard voltage and enable an observer at a distance to see whether the actual voltage is above or below the normal. This stationary pointer is not used on ammeters, as it would be of no value, since the strength of the current is controlled by the demands of the circuit and cannot be adjusted. The voltage, however, should remain constant, and if it is too high or too low it can be adjusted.

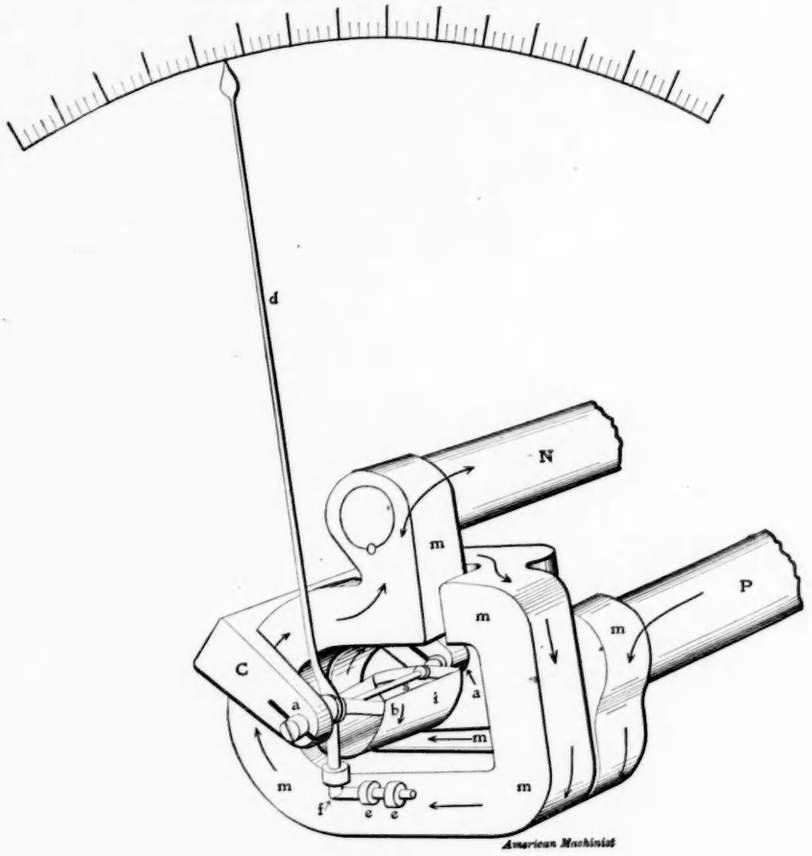


Fig. 12

THE WIRT AMMETER.

The mechanism of the Wirt instruments is shown in Fig. 12, which is a perspective view of the working parts of an ammeter. The current enters the system through rod *P*, which is connected with the line wires. It passes through *m m m* in the direction indicated by the arrows, and finally reaches rod *N*, and thus returns to the main line. The bent rod *m m m* is made of copper, and in instruments of the largest size consists of but one turn. As the size of the instrument reduces, the number of turns is increased, and for very small capacities the rod is replaced by a round wire, which is wound into a coil of the same form as *m m m*. This coil, for instruments of large capacity is made of cast copper, the several turns being riveted together. The current flowing through *m m m* develops a magnetic field, and this acts upon the cylindrical sheet *i*, which, as can be seen, is secured to the shaft *s*. The action of the magnetism developed by the current is to draw *i* down so as to swing it around opposite the curved end of *m m m*, the direction of motion being indicated by arrow *b*. The pointer *d* is secured to the shaft *s*, and therefore it is moved along the scale when *i* is moved. The L-shaped lever projecting down from the shaft has a thread cut upon the side extension, and upon this small nuts are placed, so that by screwing these back and forth the instrument may be adjusted. As there is no permanently magnetized steel around the operative parts of this instrument, it is not liable to get out of calibration, and when once properly adjusted it should remain so, if not subject to usage so violent

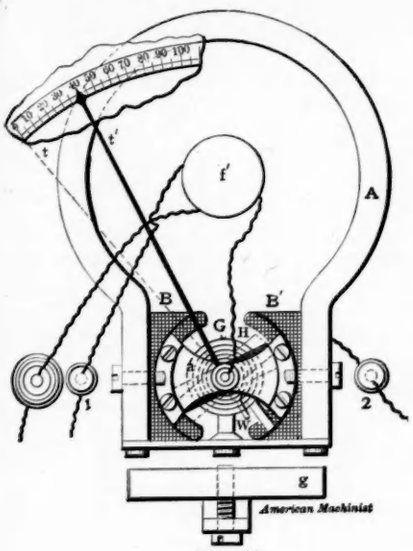


Fig. 13

PLAN OF THE WESTON INSTRUMENTS.

as to disturb the set of the moving parts. The objection to this type of instrument is that on account of the magnetic friction, or hysteresis, the action is somewhat torpid, and the pointer fails to respond to very rapid changes in the strength of current. This objection, however, is more theoretical than real, for by making the iron sheet *i* very thin the retardation in the magnetic action is reduced to an inappreciable amount, so that even for the most sudden changes in current strength the movement of the pointer is practically coincident with the variation in the current, and for ordinary changes the indications of the instrument need not be more than a small fraction out of the way. For very slow changes in current strength the pointer will move in time with the current, but when the changes are sudden the pointer may lag behind possibly 2 or 3 per cent.

Those who manufacture instruments that operate upon the principle of Fig. 6 maintain that it is better to have an instrument that is a trifle sluggish, but not liable to get out of adjustment, than to have one that is very sensitive in action, but which can easily get out of adjustment, so that for a given current strength it may register 100 amperes one day and 125 amperes a few weeks thereafter.

The well-known Weston instruments act upon the principle of Fig. 3, with a slight modification in construction which will be explained presently, this change being for the purpose, mainly, of reducing the liability of getting out of adjustment. The working parts of these instruments are shown in Figs. 13 to 17, Fig. 13 being a plan of the entire apparatus. In this figure *A* is a permanent steel magnet, to the ends of which iron pole pieces *B B'* are secured. In the center of the circular space between the faces of these poles a drum *G* is placed, this being made of soft iron. It will thus be seen that an annular space is left between these two parts, and in this space a coil of wire is placed. The relation of these parts is better shown in Fig. 14, in which *M M* is the permanent magnet, *A* the central drum of soft iron, and *C* the wire coil. The drum *A* is held stationary in its position by means of screws that pass through the plate which connects the ends of the magnet. The wire coil is secured within a frame *J*, Fig. 16, which is provided with pivots *K K'*, that rest in bearings *Q*, Fig. 15. To this frame is attached the pointer *t'*. As soon as a current begins to flow through the coil a rotative force is developed which tends to swing the pointer around to the right, but this rotation is resisted by spiral springs attached to the top and bottom of the frame, as shown at *s s* in Figs. 14 and 15. These springs not only provide the resisting force which counteracts the effort developed by the reaction between the magnet and the coil, but they also serve as the connecting wires between the movable coil and the stationary binding posts 1 and 2, Fig. 13.

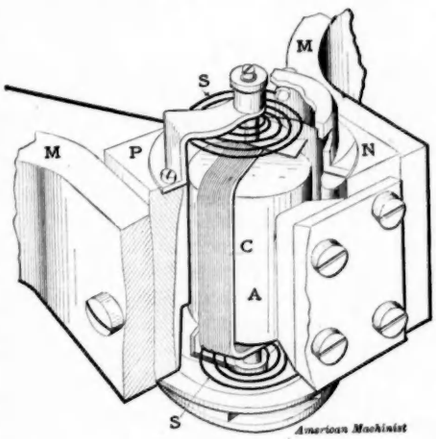


Fig. 14

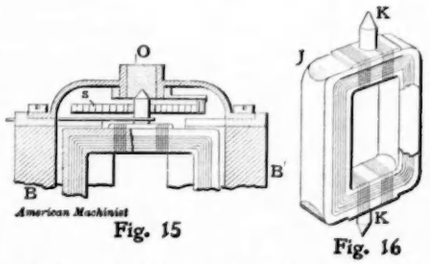


Fig. 15

Fig. 16

ENLARGED VIEWS OF THE WORKING PARTS OF WESTON INSTRUMENTS.

Figs. 15 and 16 show in detail the construction of the coil, and also the pivots upon which it swings. The bar *g*, shown in Fig. 13, is made of iron and is for the purpose of adjusting the instrument. As this bar is made of iron, it diverts some of the magnetism of the permanent magnet through it, and thus away from the annular space in which the coil rotates. The nearer *g* is to the ends of the permanent magnet the greater the amount of magnetism diverted through it and the weaker the magnetic field between the poles *B B'*.

It will be seen from an examination of the several figures illustrating this instrument that if it did not contain the stationary iron drum *G*, Fig. 13, it would be the same in principle as Fig. 3, although far more elaborate in constructive details. The drum *G* does not change the action in any way, but increases the reliability, as the presence of the mass of iron in the center of the field intensifies the latter, and also prevents the permanent magnet from becoming gradually weaker. Permanent magnets soon lose a considerable portion of their magnetism if the ends are left disconnected, but if an iron keeper is attached to them the magnetic strength changes very slowly. In the Weston instruments the iron drum *G* serves the same purpose as the keeper in ordinary horseshoe magnets. The presence of this drum, however, causes the instrument to be affected by the magnetic friction, for the current flowing through the wire coil develops a magnetization of its own, and this magnetizes *G* in a direction transverse to the magnetization of the permanent magnet. This transverse magnetization developed by the current is retarded by hysteresis, and on that account the indications of the pointer are not as accurate for violent changes in current strength as they would be with *G* removed, but the difference is practically too small to be noticed, while the gain in permanency of adjustment is far more than enough to offset it.

The instruments made by the Whitney Company are constructed upon the principle illustrated in Fig. 2; that is, they have a coil of wire set between the poles of a permanent magnet, as in the Weston instrument, but this coil is stationary, and the moving part is a small bar of soft iron which is pivoted within the coil. As this bar is magnetized by the current flowing through the coil, its magnetic intensity changes with variations in current strength, and therefore the movement of the pointer is retarded by hysteresis. The interference from this cause, however, is made practically insignificant by making the bar so small that it is magnetized to a very high density even with the weakest

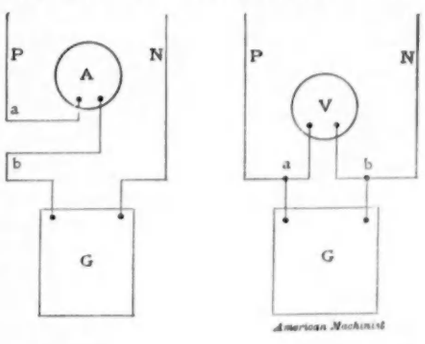


Fig. 18 Fig. 19

CONNECTION OF AMMETERS AND VOLTMETERS IN THE CIRCUIT.

current that is likely to pass through the coil, and on account of this very high magnetic density the retardation due to magnetic friction becomes exceedingly small relatively.

Instruments constructed upon the principle of Fig. 8 are made by several prominent manufacturers, but they are used principally for alternating current systems. They are also made in the form of direct reading wattmeters, and also as recording wattmeters and voltmeters, which will be explained in a separate article.

When an ammeter is made of such a capacity as to be able to indicate currents of one or two thousand amperes, the coil that carries the current must be made of large cross section. Generally one square inch of section is allowed for each thousand amperes, from which it will be seen that an ammeter capable of measuring, say, 5,000 amperes, would have a coil of rather large proportions. With a coil of such large size it would be necessary to increase all the other parts of the instrument in proportion. The increased size of the instrument, while objectionable, would not of itself be anything serious, but the connections between the instrument and the main line would have to be of the same formidable dimensions, and they would in many cases take up so much room back of the switchboard as to render it necessary to increase the dimensions of the latter. To obviate all this trouble it is common, although not universal, practice to actuate the ammeter by means of a small portion of the total current, this portion being derived by using a shunting resistance. In this way the instrument is in reality traversed by a current that may not be more than a few per cent. of the number of amperes it indicates. From Fig. 17 the way in which an ammeter is connected when provided with a shunt can be understood. The rods *P* and *N* represent the main line, and *S* is the shunt. The current that passes through the instrument runs through wires *a* and *b*. If the total current is, say, 1,000 amperes, 990 amperes may pass from *P* directly to *N* through *S*, and the remaining 10 amperes will flow through wire *a* to the ammeter, and from the latter back through wire *b* to the *N* side of the shunt.

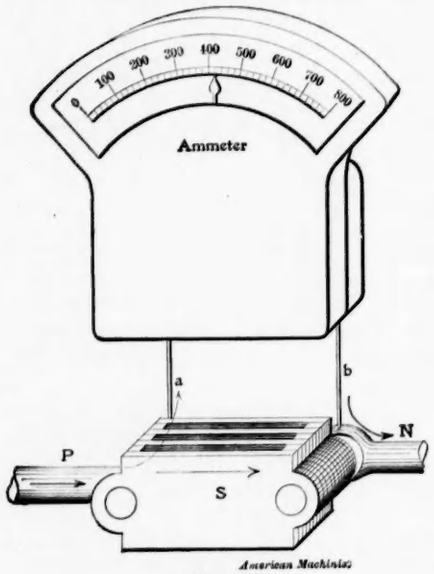


Fig. 17

AMMETER CONNECTED WITH A SHUNT.

By the aid of Figs. 18 and 19 the way in which ammeters and voltmeters are connected with the circuit can be clearly understood. Fig. 18 shows the connections for an ammeter when the size is small and the whole current passes through the instrument, in which case it is said to be connected in the main circuit, or in series. The rectangle *G* represents the generator, and *A* is the ammeter. The wire leading from the left side of the generator passes to the instrument, thus leading the whole current to the latter. After passing through the ammeter, the current reaches line wire *P*. If the instrument is connected with a shunt, then the shunt *S* of Fig. 17 is placed between the points *a b*, so that the greater portion of the current passes directly to line wire *P* and only a small portion goes through the ammeter. The amount of current that will pass through the instrument will depend upon the relative resistance of the coil and connecting wires and of the shunt *S*.

Fig. 19 shows the way in which a voltmeter is connected, and all voltmeters are connected in the same way. Here it will be seen that the two wires from the generator *G* pass directly to the line wires *P N*, and that the two wires that lead to the voltmeter *V* connect with opposite sides of the circuit, at the points *a b*. In consequence of this connection the strength of the current that passes through the instrument is dependent upon the voltage, or electrical pressure between the points *a* and *b*, which are the opposite sides of the circuit. If the voltage increases, the current through the instrument increases, and if the voltage drops the current is reduced. The movement of the indicator is governed by the strength of the current, and this being governed by the voltage the movement of the indicator is in accordance with the changes in the voltage.

Corrosion of Metals in Sea Water.

Some interesting experiments upon the corrosion of metals in sea water have been made during the last two years at Kiel. The method followed was to cut in two twelve samples of the metals to be tested, nine of which were then submerged in the sea water, while the other three were held to serve for purposes of comparison.

At the end of eight months three of the specimens immersed were taken out of the water and compared with those that had been retained outside. At the end of sixteen months three more were taken out, and at the end of twenty-four months the three last.

These samples were composed of alloys of copper rich in zinc, of bronzes with a small proportion of zinc, of bronze free from zinc, of pure aluminum bronze, and of aluminum bronze containing some zinc or zinc and iron. The last showed an especial resistance to corrosion, not having been attacked at all in the two years of immersion.

The alloys containing zinc gave the least satisfactory results. The alloys of copper and tin and of copper and aluminum, and the bronzes containing iron resisted corrosion perfectly, although they were in contact with iron in the water. The bronzes containing iron placed in the sea water in contact with the bronzes containing tin showed a more or less notable attack.

An important point for the prevention of corrosion is to avoid placing these alloys in contact with metals that are electropositive in relation to them.

Punching Holes with a Rifle.

"Up at my camp near the Four Peaks," told Jim Bark, the well-known cattleman, "the boys are all handy with a rifle. We've a lot of guns up there. The old-fashioned black-powder Winchester has been discarded and nothing but the best goes. Most of the new guns were bought during the Spanish war, when we would experiment all day with tree trunks and rough trenches, learning the art of war at home. We found that a bullet from one of the new Winchesters, driven by smokeless powder, was good for 4 feet and more of pine timber and for more than an inch of iron.

"I thought the boys had done about everything in the shooting line that could be done long ago, but I was mistaken. I sent them up a wagon. In hauling down some firewood they broke the bolsters all to flinders. The bolsters hold up the wagon bed, you know. Well, the boys figured out all right the rebuilding of the wood parts, but came near being stumped on the iron fixings. They got some old iron wagon tires and cut them in proper lengths, but hadn't a way that they could see to punch the necessary bolt holes. Finally the question was solved. One of the boys carefully marked the places for the bolts, stood the piece of tire against a tree and put a bullet, 30-caliber, through the tire at each place marked. It was a novel sort of blacksmithing, but it worked."—"The Arizona Grapevine."

A British reader writes: "I have bought a considerable number of machine tools through seeing the advertisements in the paper. In fact, thereby one is often better posted of improvements than the selling agents on this side."

Letters from Practical Men

Attaching Cogs of Gear Pattern.

Editor American Machinist:

All pattern-makers are aware of how much work and time it takes to make wooden cogs and dovetail them into the

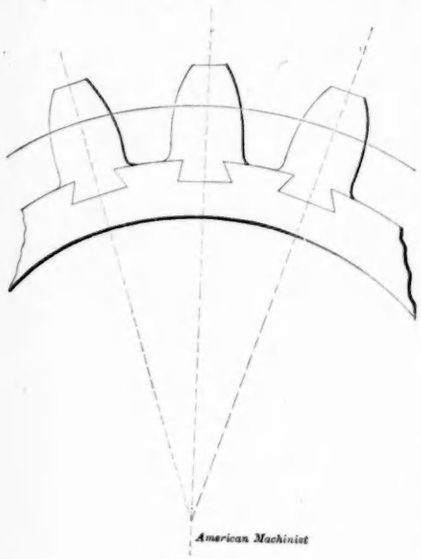


Fig. 1

COMMON METHOD OF ATTACHING COGS OF GEAR PATTERNS.

rim of a gear-wheel pattern by the customary method, as shown in Fig. 1. This alone ought to be enough to condemn the practice, but there are further objections,

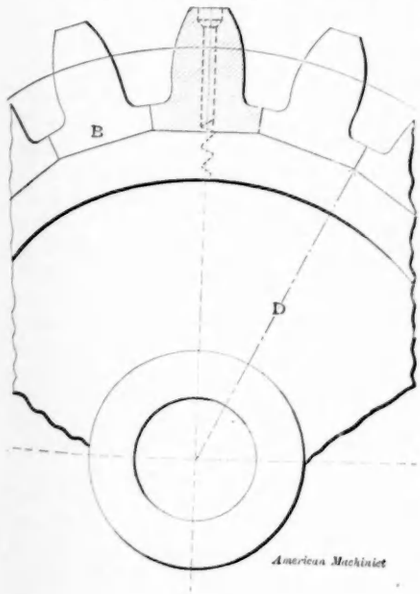


Fig. 2

NEW METHOD OF ATTACHING COGS OF GEAR PATTERNS.

one of which is that the feather-edged fillet left to form the clearance curve of the tooth will nine times out of ten break off, and thus weaken the tooth in the cast wheel. I have visited quite a number of shops and taken particular notice of the methods that are followed in attaching cogs to gear patterns. I notice that pattern-makers generally dovetail the cog into the rim, or if not, they merely curve the bottom of the tooth, to conform to the circumference of the blank and fasten it on with screws; but this method still leaves the feather-edge fillet.

By the dovetail method it takes one of our best and quickest pattern-makers just two days—twenty hours—to make a bevel-wheel pattern of thirty-six cogs, 1½-inch pitch. This includes making the arms and putting in all that is necessary to make a complete pattern ready for the foundry.

By way of experiment, in order to prove the superiority of the method shown in Fig. 2, I had the pattern-maker construct a similar wheel with the cogs attached, as there indicated. He made the wheel in sixteen hours, showing a gain of four hours, it being understood that the pattern-maker was not informed that he was doing it as an experiment in time, nor ordered to hurry up. We have applied this method to wheels both bevel and spur, from fourteen cogs, 1¼-inch pitch, to 151 cogs, 2½-inch pitch, and have never had any trouble from loose cogs.

The drawing is self-explanatory, yet I will add a simple description of how the work is done. The blank is turned as usual, only instead of making the outside diameter equal to that at the root of the tooth, we usually give it a radius ¼ inch less. The circumference of the wheel is then marked off with as many spaces as there are to be cogs, and the outer surface between the points of division is flattened off *(B)*, which operation is very simple and easily accomplished. The blocks from which the cogs are to be made are now built on the blank in the usual manner and the wheel put in the lathe and turned to its required diameter at the outside of the teeth, after which it is taken out and the teeth are laid out as usual. It will readily be seen that there is no difficulty in regard to feather-edge fillets or of the teeth coming out after having been secured to the rim by two screws. These screws are usually put in at the top on bevel pinions, but on spur gears and pinions having rims they can readily be put through the rim.

I have shown this method to several firms who have adopted it, which has encouraged me to present it here. S. P. Y.

Philadelphia.

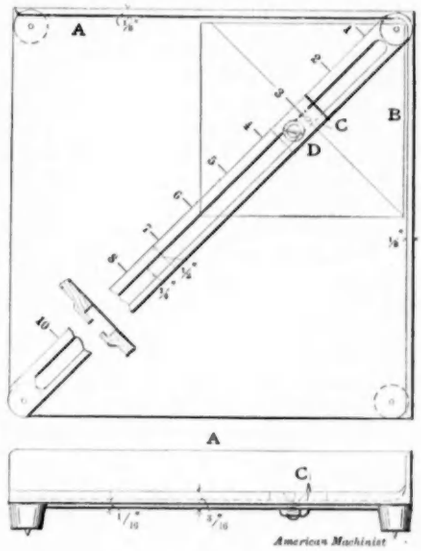
Centering Device for Pattern Makers or Wood Turners.

Editor American Machinist:

While waiting in the pattern shop the other day I noticed lying on the bench a square iron plate like that shown in the cut, and I found that it was a centering device for wood turners, which the proprietor, an old pattern maker, had invented for his own use several years ago. It was new to me, and I thought there might be many others to whom it would be of interest and who would have use for such a device, for it seems to be a very useful one to wood turners, who often have several hundred pieces of a kind to center.

To center a piece, take one, say, 3 inches square, loosen the screw *D* in the sliding block carrying the center punch *C*, set the slide at 3 and clamp. This brings the center punch 1½ inches from each of the sides *A* and *B*. Now, if one end of the stick is placed in the position shown by the dotted line, its center will be directly over the punch *C*. A blow on the opposite end drives the piece of wood upon the punch; reverse the piece, another tap, and it is centered ready for the lathe.

The question that arose in my mind after examining this simple, but useful, device was, Why did not the inventor patent it and offer it for sale? I found that he had



A WOOD TURNER'S CENTERING DEVICE.

made a number of them and given them away. A few he sold; but, like many others, he did not stop to consider that what was a labor-saving device in his or his neighbors' work might fill a long-felt want for thousands of others in similar pursuits, and thus another chance for a modest income, or perhaps a small fortune, was allowed to pass unheeded. S. B.

[Possibly the inventor of the device had had more experience with patents than our correspondent.—Ed.]

A Trade School in Springfield.

Editor American Machinist:

I have been very much interested in trade schools and what has been said concerning them in your paper. "Where is the old-fashioned, all-round machinist, that in these days goes by the name of tool maker, coming from?" is one of the questions of the day. The duplicate system of doing work has driven the machinist to specialties, and we now have lathe, planer, milling machine and vise hands. The big

shops have no use for a machinist unless he be a tool maker, and the tool maker is growing scarce.

The apprentice system is going, and no matter how anxious a boy may be to learn a trade his chance of becoming more than a mere machine operator is growing less each year. There is the technical school, but many cannot afford to spend the time and money necessary to attend that.

In this city there has been established, in connection with the public schools, a Mechanic Arts High School, where, in addition to the sciences, mathematics, modern languages, English and other high school studies, the principles which underlie the chief operations of the mechanic's trade are taught in a practical way. On leaving the grammar school a boy has the choice of a four-years' course in the regular high school or in the Mechanic Arts High School. In addition to the latter institution there is an evening school of trades, which is, I think, the only *public* trades school in the country. Here there are classes in mechanical drawing, plumbing and tool making. The class in tool making has thirty in two divisions. Each division meets two evenings a week, from 7.15 to 10.30, for machine work, which gives each man seven and one-half hours machine work per week. One evening the class receives instruction in mechanical drawing and the practical mathematics that every machinist should have a knowledge of. An occasional lecture is given by a specialist.

The aim of the school is to turn out, not theoretical, but practical workmen, and with this end in view two regular tool makers were secured as instructors for the two divisions. The class is composed of young men from twenty to thirty years old, operatives in the shops of Springfield, each of whom realizes what it means to be a *one-machine* man, and is there for a purpose.

The work done by the classes becomes part of the school equipment. Besides the regular amount of tool work they expect to build six speed lathes for the woodworking department, and special apparatus for other departments. The evening classes thus furnish much valuable training and supply tools and machines for the city.

C. H. Wilcox.

Springfield, Mass.

The Use of Technical Journals and Books.

Editor American Machinist:

One of the commonest things is to have fellows asking about what books they shall get to learn this thing, that thing, or the other thing. I have personal inquiries of this kind, and I know that the papers have the same kind of questions, because I often see them trying or pretending to answer them. What book shall I get to qualify myself to take a place as a marine engineer or a locomotive engineer, or what book will tell me how to run a lathe? I actually knew of a case of a proprietor of a machine shop, who was no mechanic either by birth or experience, but who had caught on to the fact that in order to succeed in machine building you must at least have some good tools, and he had bought a milling machine, and when the machine came into the shop he wrote to the builders for a book of instructions that would tell the men how to run the machine. I happened to be foreman of the shop at the time, and you can bet I took pains to let those milling machine builders know that the request for the milling machine instruction book did not come from me. How ready would be the builders of lathes and planers and the other tools to send out books of instruction that would make their tools efficient, and so encourage the sale of them; but you never hear of their doing it, because they all know that such things cannot be taught in that way. When hiring a man for any position in any shop the inquiry always is, Where have you worked? and What have you done? and it never is, What books have you read or studied? Why, no book that ever was written, nor all the books that ever were written, could teach even "The Man with the Hoe" all that he should do with that interesting implement. Manual and digital dexterity, and the facile manipulation of tools, are never acquired except by the actual and repeated doing of difficult things until the difficulty is vanquished and disappears. A pianoforte "instruction" book consists almost entirely of the scores of exercises to be gone over and over, and a machinists' instruction book, if such could be written, would be something of the same character, and it could never then be learned by even the most industrious memorizing.

And this is not saying anything against books. We only need to remember what they are for. I owe too much to them to ever think of getting on without them, any more than a business man can get along without his strictly-kept ledgers. Books eventually record everything that has been done and which is worth saving, and so, as we progress by accumulation, we must put as much as we can of it into books, and there are those whose mission it is to do this thing, and their services prove their place and value as well as any other.

But, necessarily, their work is never up to date. "No fresh truth ever gets into a book," said the "Autocrat of the Breakfast Table" more than forty years ago—I read it before the ink was dry. It might have been written when they first began the making of books, or it might be written to-day with equal truth and pertinency, or, rather, with more point now than ever before, because we now have some trade journals in close touch with the most active and successful and original workers in the shops, and everything new gets into these before it gets into the books; and when it does get into the books, as it finally must and should, it is then not only second-hand matter, but we thus have evidence of its second-handedness.

The great merit and the one justification of the technical journal is in its up-to-date-ness. The most absurd thing is the bringing of things from books and stuffing them into the papers. This makes it not only third-handed matter, but it is also matter discounted and robbed of its association value. The idea that the pages of a trade journal may be filled with any old thing is common enough, but there is a kind of news in such things that belongs to them just as much as the telegraphed news from the seats of war or from national capitals belongs to the daily papers. I notice that a periodical which has to do with hardware and the tinshop has just discovered the jig, and it proceeds to tell its readers what a good thing it is, and how it pays to use it, which is just the same as if the New York Herald should tell us that the Dutch have taken Holland. It is probably too early yet to be told that we ought also to be using twist drills, but we may expect it at any time. I suppose I have seen, at one time and another, in pseudo trade papers a hundred different beginnings of elementary instruction in mechanical drawing, which is not much better, because all of that business has been written up over and over again more completely than the papers ever pretend to do it, and is accessible at all prices according to the taste of the individual.

The book writer deals mostly with what has been, while the trade journal has to do much more with what is and what is coming. The trade journal cannot be made by one writer as the book can, but needs the active co-operation of the many, and it must be in touch with many more. I can understand much better how a live mechanic can get along without many technical books than I can his living and thinking he can know what he ought to know without his trade paper. I have an idea that the trade papers are to become more important and useful and necessary as the years roll on, and that no one can keep the run of progressive development and attainment without them.

Tecumseh Swift.

The Dollars and Cents Value of an Hour.

Editor American Machinist:

Of late I've been doing some "independent thinking," as Mr. Tecumseh Swift would say, and it has occurred to me that some of your readers might do some thinking along similar lines with profit—hence this letter.

While looking around for ways and means of increasing my income, I ran across a factor, the importance of which has heretofore been neglected by me. All my working lifetime, I have been devising ways and means for increasing the income of my employers, my own reward coming

in occasional increases in pay. But raises come slowly after one stays in one place very long, and proportionally slower as the pay high-water mark is approached.

While revolving these matters, and discussing whether or not it would be advisable to ask for a raise or to wait patiently for it to come, as I had done in the past, the thought suggested itself to me to look up my time losses for the past year. Having preserved all my time-cards, this was an easy thing to do. The total of these losses when footed up showed $39.90 for the year. These figures staggered me, for I had never before realized how quickly an hour lost now and then would run the dollars out.

I've pondered long and profitably, Mr. Editor, over those figures, and while I am a pessimist about the value of good resolutions, I know that my resolution to lose less time this year will bear good dollars-and-cents fruit. I also feel that I've discovered a source of income or of profits that I need divide with none. As a result of my investigations, I see visions of at least one raise (a small one, to be sure) that won't come after an interview with the "boss," or that won't follow one of those tiresome waits for him to take the initiative. I trust that my experience will suggest to some, at least, of your readers, that they can also profitably look up the matter of the dollars-and-cents value of an hour.

SACHEM PARKS.

"Crank Shafts for Large Engines"—Allowable Pressure on Bearings.

Editor American Machinist:

In the article on the above subject, by W. H. Booth, in the "American Machinist" of February 15, I notice one or two points which seem to me misleading.

He first takes up the question of bearing pressures, and reasons from what seems to me very insufficient data. He states that an examination of a number of large engines showed that 130 pounds per square inch projected area gave perfectly satisfactory results. The inference apparently intended is that if in another engine this pressure be not exceeded, it, too, will be satisfactory. That this is the intended inference is borne out by the absence, throughout the article, of reference to any modifying factor, so far as heating of the bearing surface actually obtained is concerned.

Now the writer has designed bearings which have been in constant use for nine years, without appreciable heating or wear, where pressures reach 1,200 pounds to the square inch projected area, and others for approximately the same size journals, where pressures do not exceed 30 pounds to the square inch, and yet, having reached practicable limits in reducing pressures, it has been necessary to provide water-jacketed bearings to prevent dangerous heating.

The difference lay solely in the point Mr. Booth omits, and which is just as vital in the design of a bearing as is the load, and that is, the speed. In the first case the speed or rubbing surface was perhaps 3 feet per minute, in the second it was 1,200 feet. If the pressure on the bearings of two engines figure out the same number of pounds per square inch, but the first runs faster, or has a larger shaft, or has both greater speed and larger diameter shaft, the tendency of the bearings to heat will be correspondingly greater in the first engine than in the second. As the heating of a bearing depends solely upon the work lost in the bearing and on its ability to radiate the heat caused by this lost work, it is evident that, supposing bearings of the second engine not to be excessive, the pressures per square inch must be reduced in the former. This can only be done by lengthening the bearing, as increasing the diameter increases the rubbing speed in the same proportion in which it reduces the pressure per square inch, and so does not decrease the work per square inch. Less work per square inch, to meet the allowable radiation per square inch, is what we are after, so we must lengthen our bearing. In this way we get more square inches, less unit pressure, and the same rubbing speed as before. But if we lengthen our bearing, we may on that very account have to increase the diameter of the shaft, because of the point brought out by Mr. Booth, that the shaft must have considerable stiffness not to bend enough to spring away from its bearings unduly. This enlarged diameter still further decreases the allowable pressure per square inch, for, as just pointed out, the work per square inch bearing (or projected bearing) area remains the same if the length of bearing is maintained.

The above argument, of course, is all based on the assumption that the whole range of absolute bearing pressures under discussion does not get beyond the limits of good lubricating conditions, where the shaft always has a film of oil between it and its bearing. This condition, however, would not be departed from in any engine bearing, and is therefore a proper assumption.

The above point, the vital connection between the rubbing speed, the pressure, the radiating capacity and the heating of a bearing, is too frequently ignored. Variation of any of the first three conditions is as vital in its effect on the heating as is the bearing pressure, but the other two are frequently forgotten.

At another place in the article in question Mr. Booth suggests starting the engine off with the dynamo armature just sufficiently out of magnetic balance to offset its weight, with consequent advantage to the bearings. This would not do, because unbalanced magnetic circuits would mean unbalanced electrical circuits—which is just what the dynamo designer bends every energy to avoid.

The best way is to make ample bearings, for they are cheap compared with the troubles unbalanced magnetic and electric circuits, due to undue wear or spring (or initial setting up), can bring about.

S. L. G. KNOX.

The Beginning of "The Judge's" Apprenticeship.

Editor American Machinist:

"Well, my son," said the parent of a young man of about eighteen winters, "I have a letter from my old friends, J. Hawe Kerr & Bro., of Lawtown, Kan., offering you an apprentice's position. Now, you may make your own choice. You can either go into the music store with me, and I will advance you as well as I can in the business of an all-round musician, or you can begin the machinists' trade with Kerr Bros., and with your decided inclination in the mechanical line you should make a success. Perhaps, if you are economical, you can take a mechanical engineer's course at the Stevens Institute or some one of the best technical schools, after your apprenticeship."

The present limit of means had terminated Savery Archimedes Watt's schooling with a Hoosier high-school course, with smatterings of Latin, botany, mental and moral philosophy and other studies of equal value to the future engineer or inventor. Savery Arch. had evinced, ere this, decided mechanical genius, by building water wheels and steam engines, foot-lathes and scroll saws and various machines, useful and otherwise—usually otherwise. Although the lathes, saws and water wheels usually ran with degrees of success, the engines were not highly economical. The cylinders were usually made of lead, and the other parts were largely of wood. Forty pounds steam was ordinarily required to make the crank shaft rotate. As S. A.'s mechanical laboratory consisted of an heirloom set of cabinetmaker's tools, model 1776, the workmanship of his machines was unconventional. His business capital was an allowance of $5 a year, which was supplemented by his receipts from the manufacture of doll's furniture, sign-painting, playing the organ for private entertainments, playing with the band, turning baseball bats, job printing and other lucrative occupations. With this broad preparatory our young man, deciding on a mechanical career, entered the employ of Kerr Bros. at a salary of $1 a day.

His first job was drilling ¼-inch screw holes in several hundred hard castings for washing machines. Hard castings were the rule at Kerr Bros.' shop, and flat drills were used almost entirely. They were usually tempered about a light brown and run with about a quarter the present feeds and speeds used in manufacturing. The manager, who was an experienced ma-

chinist, showed him the drilling lathe with wooden bed, fastened the drill, forged on a ⅝-inch octagon shank about 24 inches long, into the chuck with a set-screw, started the machine and drilled one casting to stow Ark. how it was done. Then he went uptown and didn't appear again till after noon. Ark. succeeded in drilling a number of pieces without difficulty, and pretty soon he decided to feed a little faster and make a record if possible. The first result of this move was a broken drill. Ark. at once sought advice from William, the younger of the two machinists, who proved to be obliging and told him to have the blacksmith dress the drill and he (William) would show him how to grind it. Ark. now felt better, and, as the smith happened to be in a fairly good humor, found no difficulty in getting his drill dressed. William then ground it for him with clearance enough to let it run around a corner, and Ark. started again. All went well for about an hour, when the drill began to squeal. William now advised him to grind the drill, which being done stopped the music.

The next job was drilling ⅜-inch pinholes through some 1½-inch bars. Ark. took a pair of 6-inch outside calipers and a scale and tackled the pile of drills of assorted shapes and sizes. Finding one that his calipers would push over pretty hard, he chucked it and began to drill, using plenty of oil, as the manager had instructed. All went well until the drill broke off after drilling about 1 inch. The shank being too large to go into the hole any deeper, the drill became choked with chips. Well, the smith didn't look quite so pleasant this time, but he dressed the drill without complaint, drawing the shank small enough to clear itself. The affable William, who had had about six years' experience at Kerr Bros., advised drawing the shank, and told Ark. to clean the chips out once or twice to prevent choking.

The next job was threading a lot of ⅝-inch bolts with an adjustable die in the bolt cutter. Several of the threads were cut rather long because the friction clutch didn't work very easily, and Ark. didn't begin to persuade it soon enough. In a limpid pool, of the hue of a Podunk frog pond, rested the useful article with which civilized man usually eats soup. The first was a cheap mineral oil and the latter the only oil pump. The ⅝-inch bolts finished, Ark. began on some 1-inch rods and nuts. The nuts made no worse trouble than to illustrate "heat as a mode of motion" when Ark. handled the first one tapped. The rods were less satisfactory. The tool was a square, solid die of uncertain antiquity, and without clearance of any kind. As soon as the bolt had fairly entered the die, a musical tone was produced similar to the vocal achievements of an appreciative canine accompanist to an amateur cornetist, but much more powerful. Ark. was so interested in this odd effect that he allowed the oil pump to rest for a few seconds. During the rest the manager came up, and, grasping that implement with evident traces of excitement, worked it actively, but too late. The music had ceased and the thread of the die's discourse was lost. When the machine was reversed the die refused to feed back, and drastic measures were necessary to get it off the rod. When the rod was cut off and the next thread started, the manager gave explicit instructions for using oil actively and punching the chips out of the die with a spike, to keep them from choking, and trying a nut on several of the threads to see that it fit properly. Ark. tried the nut on the first thread about three turns. It was a nice fit, so far, so he threaded about half a day's work, trying the nut on three turns occasionally. About this time William the affable came along and tried the nut on four turns and no further. It wouldn't go any further. The tap couldn't well be enlarged, so the manager had the blacksmith close the die a little. That refractory tool now refused to cut a thread at all, and the purchase of a new die of the adjustable chaser kind ended the difficulty.

SAMUEL A. BETTER.

Liquid Operated Machine Tools.

Editor American Machinist:

The discussion on the above subject, inaugurated by Mr. Tecumseh Swift in your issue of December 21, and continued by Messrs. Hill and Coombs, in your issues of January 18 and February 1, respectively, has excited considerable interest on the part of your subscribers at the shops of the Dubuque Turbine and Roller Mill Company, simply because there is in daily operation there a very successful example of a hydraulically operated machine tool of home manufacture, which is, perhaps, one reason Mr. Coombs overlooked it in his list of such tools. The machine in question, Fig. 1, is a vertical planer, used in this instance for corrugating the surfaces of chilled iron rolls. In this machine there are some radical departures from the ordinary planer method of doing this class of work. In the first place, the roll is held stationary on centers, save for the rotary motion necessary to give the required spirality to the cut. Second, the tools are multiple, and are attached to a circular head, which obtains its motion from the piston of a hydraulic cylinder below. The cut is made on the up stroke, and the speed of the cut can be regulated

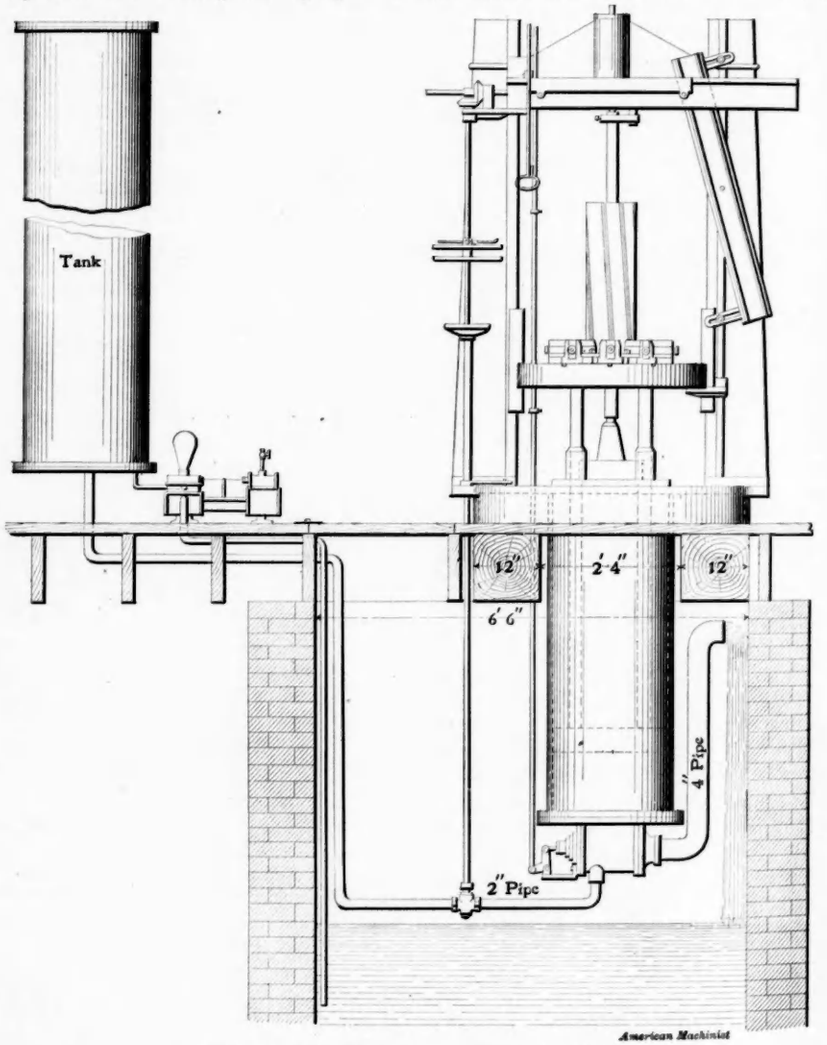


FIG. 1. A HYDRAULIC VERTICAL PLANER.

with a nicety quite unattainable by any positive mechanical movement. The speed of the return motion is naturally only limited by the size of the discharge and the law of gravitation.

In line with the above it may interest your readers to learn of another application of the liquid operating method emanating from the same inventive source, and proposed to be applied to factories as a safe and economical substitute for electricity or compressed air. The power plant, as may be seen in the rough sketch Fig. 2, may consist of a boiler and steam pump, or an engine and power pump, to force water into the reservoir and pressure pipes. Water motors connected to the pressure pipes generate the power required to drive each machine or cluster of machines, and the water that passes through the motors returns through the discharge pipes to the pump to be again forced into the pressure system. The simplicity of the water motor and its great durability are strong points in its favor over electric or air motors, and the risk of fire is much less than by any other process that can be imagined. The pressure pipes furnish a constant supply of water for fire protection, either through a sprinkler system or hydrants and short hose at each floor. In cold weather exhaust steam can be admitted into the discharge pipes or the water in the pressure system can be heated with live steam or with a furnace, and the building warmed with hot water, thus combining power, heat and fire protection in one system.

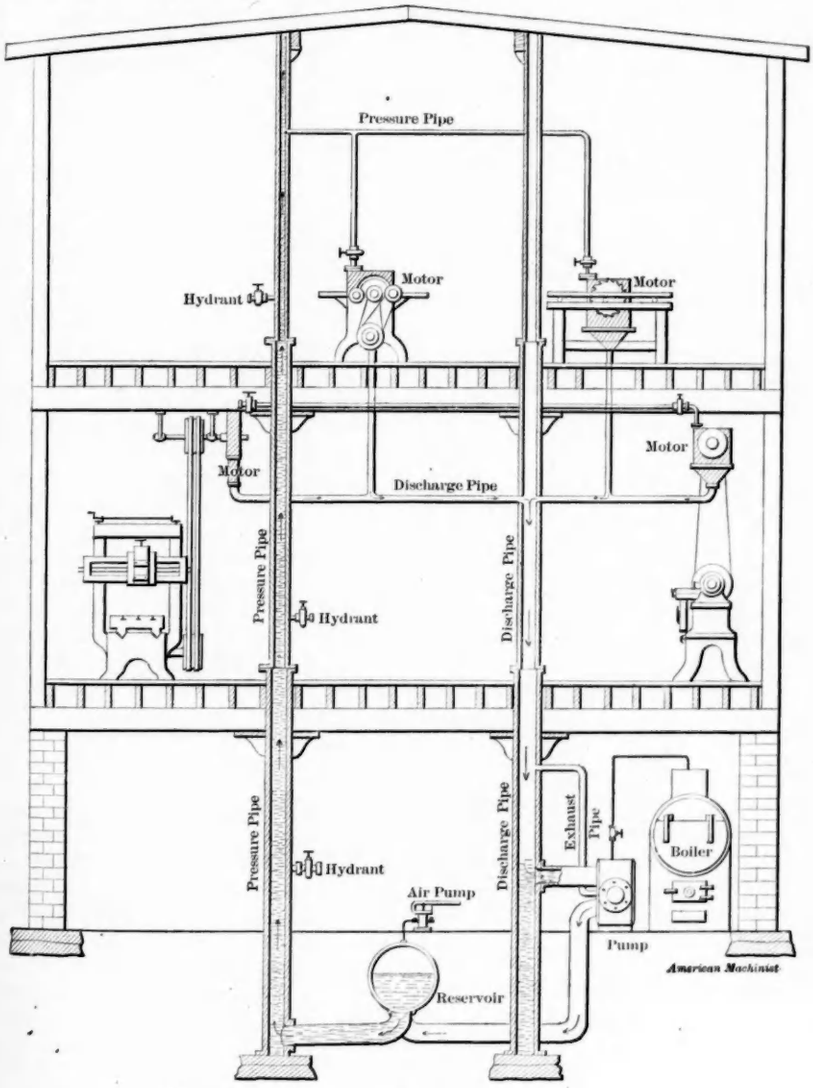


Fig. 2

A SUGGESTED WATER MOTOR SYSTEM.

Dubuque, Iowa. F. THORNELY.

Plenty of the Old Skill When Wanted.

Editor American Machinist:

I am impelled to write these few words after reading your editorial of February 1. You seem to think that the old-time skill in hand work is disappearing or dying out in the machinist trade. Indeed, most writers on mechanical topics write in the same strain. Now, I went to work as an apprentice in 1863, at fourteen years of age, and it may perhaps surprise you to know that in those days the men at the trade, and what technical papers were then in existence, talked the same way.

Even in those days men that were first-class at chipping a plane surface and then filing and scraping it dead true were rare. Among the machinists the limit of their abilities in hand work was to be able to do this, or to cut out keyways in hubs or shafts. I admit that this ability was more general than it is now, but the old-time dexterity has not died out, neither is there any probability that it will. And the men who do plenty of it nowadays, and who are much more skillful at it than any of those that have long passed away, are to be found in the ranks of the men that call themselves die sinkers and die makers, the former in drop-forging dies and the latter in dies for forming and stamping sheet metal goods, and I hope that they are still classed as machinists. I know some of them would be indignant if anyone should tell them that they are not machinists.

Now, almost everybody knows that stamping and forming metals in dies is all the time extending, and more difficult shapes are constantly being brought out. Shapes that were not thought of being made by this method a few years ago are considered not at all difficult now. Take, for instance, the article upon cast iron dies that appeared in the "American Machinist" a few months ago, in which the writer said that if they were produced by the hand planer it was a very tough job indeed. I can assure the writer of that article that they were made in exactly that way. At least, a number of them were made in that way within two miles of the "American Machinist" office. There is a continually increasing demand for ornamental work in sheet metal, and the dies for such shapes are not easily produced by machine tools. Again, in molds for celluloid work there is a great deal of work which has to be sunk that the milling machine can only help you out on, by removing the stock from the places in which it can be used; and even then it would be sometimes cheaper to do it by hand.

Take, for instance, such an article as a mouthpiece for a briar-root smoking pipe, which is used in enormous quantities. The various shapes are so peculiar that only the roughing out can be done on a milling machine. The finer work has to be done by hand, and the chisel plays a very important part. They have to be finished up like a looking glass, without speck or flaw, and the machine work that can be done on molds of this description is a very small proportion. Take another instance—a hair brush or a mirror, one of the most favorable shapes for the milling machine. The outline can be milled out very nicely, but the bottom of the mold or die will be left flat, and as the bottom must be rounded out, and the shape is usually an ellipse, it

must be cut out by hand, free from lumps and perfectly smooth, and then highly polished, which latter operation will show up every imperfection. When it is considered that the same customer may order a number of these molds, on which there will be entirely different degrees of curvature, it will be seen how difficult and expensive it would be to make special tools to do the work.

Now these die shops are not run for fun or experiment, so they resort to the hammer and chisel in the hands of a skillful man. It is the same in sheet-metal stamping. The articles are made in vast numbers in silver plate, aluminum, etc., and hand work is a very important feature in all of them. In fact, the skill of these men is such that the engravers complain that the machinists are doing a lot of their work now. It is sometimes a question whether the job should be done by the die maker or the engraver, or it is hard to determine the line where the machinist should stop and the engraver begin. In drop forging work it is much the same, except that the forms required in that work, being for mechanical purposes, lend themselves more readily to machine work, nevertheless, in some intricate work what has come to be called the old-fashioned methods are still resorted to, and the man that has this old-fashioned skill finds it a very handy thing to have around.

Now, the point that I am trying to get at is this: Here are three of the highest branches of the machinists' work in which this old-time skill is required; is it dying out? No! Rather put it this way: It is developed to a higher degree, but among a smaller number. Neither is it going to die, at least as long as manufacturing is extending. There will be always something new to be done. The people that do this kind of work can almost always get men that can do it if they are willing to pay what it is worth. But will they pay? Ah, there's the rub! Some of them, if a man asks for a little more pay, will shrug their shoulders, make excuses and talk about the hard times to get along. If a man then leaves them they will get cheap ones, and lament so that "the old-time skill is dying out;" they can't get the right sort of men. Where there is a demand there will be a supply; and for this reason there is no danger of hand work dying out. You do not have to go many miles from your office to find a goodly number of such mechanics. Of course, in the nature of things and the state of trade they are not lying around loose, neither are they to be got for the smallest possible rate of wages, such as some employers think they ought to work for.

When some genius gets up a universal vertical milling machine that can sink dies with irregular bottoms, irregular curves and elliptical shapes, corrugated or plain, also mill out square corners, machines which can be set to make any conceivable ornamental design, then there will be some prospect of there being no use for hand work; but not until then.

I beg to differ with you about your quotation, "Not for this faint we, nor mourn nor murmur." Would it not be a pity if the very foundation of the machinists' art was lost sight of?

Sometimes I have seen a good tool maker, bright and ambitious, come into a die shop where good wages were paid, get along very nicely until he got hold of a job such as I have described and find himself hopelessly stranded, and, looking about him, see old-fashioned fellows, as he thought them, making dies or press tools all around him. Rather humiliating for him, and likely to take some of the starch out of his collar, but the lesson does him good.

Moral—The man that learned the trade in the old-fashioned way, and learned it well, can keep right up with the procession; nor should any process be despised until found unworthy.

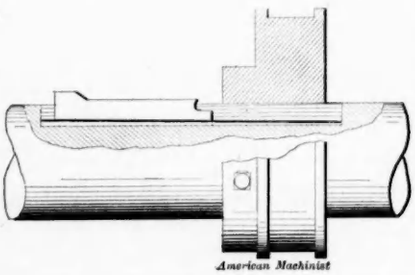
OLD AND NEW MAN.

[We are very glad to receive and take pleasure in publishing the above interesting letter, and our readers also will not fail to appreciate it. Our editorial merely called attention to the fact that machine work has so completely superseded hand work in the fields where it shows its undoubted superiority. We will never be less able to do, but always, as a whole, more able to do whatever we have to do, and our success will consist largely in the employment of the best means for each special case. Hand work will always be used where it must be, and what man has done man can do—and a little more.—Ed.]

Keyseating an Eccentric on the Shaft

Editor American Machinist:

I once had a hurried job to do on a crank shaft carrying two eccentrics, which had been secured by set screws; but as the screws would not hold it was decided to use keys. Apparently it was necessary to remove one of the crank disks to get the eccentrics off, and as we were not prepared for this I thought of the idea shown in the sketch. After planing seats in the shaft about two and a quarter times the length of the eccentric hubs, a thin strip planed to the required taper was placed in the first seat, a cutter or drift was fitted to the same, the first eccentric was placed in position and the set screws tightened. The drift was then driven through repeatedly, each time a thin strip being placed underneath, until the necessary depth was reached. The taper piece was then removed and the second eccentric hub treated in the same way. Keys were fitted, and the job was finished in about the time that would have been consumed in removing and replacing the crank disk.



KEYSEATING AN ECCENTRIC ON THE SHAFT.

C. A. P.

What is a Gas Engine?

Editor American Machinist:

The gas engine is defined in the "American Machinist," January 18, as: "An engine in which motion is communicated to a piston, working in a cylinder closed at one end, by first compressing a combustible charge of air and gas in the closed end of the cylinder," etc.

It is difficult to devise a definition to which exception may not be taken, but the effort from which I quote appears to ignore gas engines having cylinders closed at both ends, as well as those in which the charge is compressed in the crank casing.

Double-acting engines of the Griffin type have been built to 70 horse-power, by Messrs. Dick, Kerr & Co., of Kilmarnock, Scotland. Grover's "Treatise on Gas and Oil Engines" gives considerable space to double-acting gas engines of this type. The Benz & Co.'s first gas engines patent, March 26, 1884, describes a cylinder closed at both ends, with a stuffing box at one end for the piston rod. The back end compresses the mixture and receives the impulse after the explosion; the front end of the cylinder is filled with air, and on the next stroke the piston compresses the air charge into a reservoir communicating with the other end of cylinder.

The Daimler motor has an airtight crank case closely fitting around the disks, the air being drawn into the crank case and compressed by the action of the pistons. Two gas motors, both said to give good results, are similar to rotary steam engines. These have been built by Tygard, of Pittsburgh, and a Mr. Battey, of New York. Of the last I have no description, except the one written by Mr. Louis Lockert, of the "Chauffeur." The same authority declares the earlier Duryea car to have had a double-acting, oscillating motor. This arrangement, however, is not found on the later carriages which I have seen of the Duryea manufacture.

Perhaps, in view of the varied peculiarities of gas engine design, the Century Company might guard their reputation for precision by boiling down the definition to:

Gas engine. An engine operated by gas: see Clerk's book.

If they do not care to refer to the book, they can drop the reference and still come nearer to the truth than in their previous attempt.

Q.

The Machinists' Strike.

What seems likely to prove the most serious struggle between union labor and employers that has ever occurred here in the machinists' trade has been inaugurated in Chicago by the action of the International Association of Machinists in calling out its members there because its demands were refused by the shop owners. What is demanded by the organization is set forth by the agreement that employers are asked to sign, and which is as follows:

"Agreement between ..... and ..... of the International Association of Machinists.

"Date.....

"1. That on and after ..... the ..... agree to employ only members of the International Association of Machinists in good standing on machinists' work and die and tool work.

"2. Machinists shall be recognized as per constitution of subordinate lodges of the International Association of Machinists, and shall be either a general workman, a competent floor hand, lathe hand, vise hand, planer hand, shaper hand, milling machine hand, slotting machine hand, die sinker and tool maker or boring mill hand.

"3. The minimum rate of wages for machinists shall be 28 cents per hour, and for die and tool work 32½ cents per hour.

"4. All overtime up to 12 o'clock midnight shall be paid for at the rate of one and a half time.

"5. After 12 o'clock and all legal holidays and Sundays shall be paid for at the rate of double time.

"6. The employment of apprentices shall be in accordance with constitution of the International Association of Machinists.

"7. Nine hours shall constitute a day's work. All time worked over nine hours shall be governed in accordance with sections 4 and 5.

"8. When necessary to reduce the force of employees on account of slackness of work, the ..... Company hereby agree that employees who have been laid off will be given first opportunity for re-employment, seniority and proficiency to govern.

"9. In case of a grievance arising, the ..... Company agree to receive a committee of their employees to investigate and, if possible, adjust the same. If no adjustment is reached, the case shall be referred to the ..... Company and the Executive Board, District No. 8, International Association of Machinists. If no satisfactory settlement is agreed on, the whole subject matter shall be submitted to a board of arbitration of five persons, two to be selected by ..... Company, two by District No. 8, International Association of Machinists, and the four to choose a fifth arbitrator. The decision reached by this board to be binding on both parties to this agreement.

"10. This agreement shall be in force until March 1, 1901.

"11. Thirty days' notice shall be given prior to March 1, 1901, by one party of this agreement to the other for a renewal of the agreement, or any desired change in the same.

"Signed .....
"....."

We happen to know of at least one prominent shop, the proprietor of which agreed to pay the rates of wages asked for—frankly said that times were good and that he could afford to do so; but he refused to bind himself to employ only members of the union, and his men went out with the rest of them. The trouble has broken out at Columbus, Ohio, also, although this is said not to have been the intention of the managers of the union.

Personal.

Thomas E. James has resigned his position as general foreman of the Lima Locomotive and Machine Works, and is now master mechanic of the Champion Iron and Steel Company, Muskegon, Mich.

Frank T. Goodwin, who formerly had charge of the engine department of the F. W. Wheeler shipyards of West Bay City, Mich., has accepted a similar position with the Jenks Ship Building Company, of Port Huron.

Charles M. Schwab, who is now president of the Carnegie Steel Company, went to work in the Carnegie Iron Works at Pittsburgh twenty years ago as a stake driver at a salary of $1 a day. To-day he draws a larger salary than the President of the United States. He is only thirty-seven years old.

W. D. Ross and George Miller, who have been general foreman and pipe-shop foreman, respectively, of the United States Cast Iron Pipe and Foundry Company, Anniston, Ala., have resigned their positions to take similar ones with the new Dimmick Pipe Company in Birmingham. Henry Griesbaum, of Louisville, succeeds Mr. Ross.

Charles Yensen, an engineer, merchant and contractor located at Bilbao, Spain, visited this office a few days ago. Mr. Yensen was born in Norway, but has lived in Spain over twenty years. He was a delegate of the Chamber of Commerce of Bilbao to the International Commercial Congress at Philadelphia, and since the meeting has been traveling in America, inspecting shops and engineering work. He has sold much English and German machinery in Spain, but will probably sell some American machines there hereafter. Mr. Yensen has been appointed United States consular agent at Bilbao.

Rear Admiral Hichborn, Chief of the Bureau of Construction of the United States Navy, was sixty-one years old on March 4, when he received the congratulations and best wishes of his associates, a handsome floral tribute being presented by the draftsmen of his office and another by the clerks of the Construction Bureau. The following brief sketch of the Admiral's career, which we find in the Philadelphia "Ledger," will be read with interest: "Born March 4, 1839, at Charlestown, Mass. 1860—Started for California as an officer of the clipper ship 'Dashing Wave.' 1862—Master shipwright of the Mare Island Navy Yard at the age of twenty-three years. 1869—Appointed Assistant Naval Constructor. 1875—Promoted to be Naval Constructor. 1880—Member of the first Naval Advisory Board, which laid the foundation for the new navy. 1883—Member of the Board of Inspection and Survey, of which Admiral Porter was president. 1884—Assistant Chief of the Bureau of Construction and Repair. 1884—Special mission to Europe by orders from Secretary Chandler, to secure information and prepare plans for modernizing our dock yards and construction plant. 1893 to 1900—Chief of the Bureau of Construction and Repair, marking an advance to every grade to Rear Admiral and Chief Constructor and service in almost all capacities and duties, a career covering the different stages of shipbuilding from wood to iron and iron to steel; from sail power to exclusive steam power, which is now passing in many features into electricity."

Obituary.

William C. Ferguson, superintendent of construction for the Westinghouse Air Brake Company, died at Pittsburgh, Pa., March 3. He had been in the employ of the company seventeen years.

Addison C. Rand, president of the Rand Drill Company, died at his home in this city the 9th inst., in his sixtieth year. While Mr. Rand had not been in robust health for several years, no apprehensions were felt by himself or his friends. His last sickness was but little over a day in duration, and hopes of his recovery were entertained by his physician almost to the last. His remains were taken for burial to the home of his boyhood—Westfield, Mass.

William Wallace Rogers, of the firm of Woodward & Rogers, machinists and tool makers at 133-135 Sheldon street, Hartford, Conn., died March 1. Mr. Rogers was an expert tool maker, and by a close attention to business and strict integrity of methods advanced rapidly. He was Scotch by birth, being a native of Paisley, Scotland, where he was born in August, 1837. He came to Hartford when a young man and was employed at the Pratt & Whitney Company for several years.

Gottfried Daimler died at Cannstatt, near Wurtemberg, Germany, March 6, sixty-six years old. He was generally called in Europe the "father of automobilism." His first mechanical experience was at the engineering works of Trowley Brothers, Glasgow. He was after that as-

sociated, in Cologne, with Dr. Otto in perfecting the gas engine, being a partner with Dr. Otto for more than twenty years, and while still with him the gasoline motor, the starting point of the modern horseless carriage, was invented. This motor was taken up by the French pioneers in automobilism—Emil Levassor and the Peugeots. He was the founder of and largely interested in the Daimler Motor Company, of Cannstatt. The Daimler Motor Works at Steinway, Long Island, also manufacture under the Daimler patents.

New Catalogs.

The C & C Electric Company sends us booklets "A" and "B," respectively containing lists of some purchasers of their multipolar generators and motors and of some electric-lighting and power-transmission plants installed by them. Each is 6¼x3½ inches.

The general catalog of pumping machinery of the Geo. F. Blake Manufacturing Company, 91 Liberty street, N. Y., has been received. It illustrates and describes the lines of steam pumps and pumping machinery made by that company. Size of pamphlet, 6x7½ inches.

Manufacturers.

An oil mill is to be erected at Smithville, Texas, to cost $30,000.

The Ford Bit Company, Holyoke, Mass., is considering a location in Chicopee.

The Colorado & Southern Railroad is to erect a new machine shop and a new car shop.

A foundry will be erected by the Harrisburg Manufacturing & Boiler Company, Harrisburg, Pa.

Franklin, Pa., has secured a pneumatic tool company, called the Franklin Air Compressor Company; capital, $300,000.

E. J. Robinson, of Indianapolis, has organized a company, and will at once erect a $200,000 cement plant at Bedford, Ind.

The Collins-Hale Manufacturing Company, Wilkesbarre, Pa., furniture makers, will enlarge its factory and install new machinery.

The Barnard & Leas Manufacturing Company, makers of milling machinery, Moline, Ill., has let a contract for a wood shop building, to cost $20,000.

An Eastern manufacturing concern, em-

(*Continued on page* 39.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Rawhide, fibre and hard rubber gears. The Arthur Co. (See page 44.)

Metal novelties, we buy and manufacture. Bliss Metal Co., Providence, R. I.

80 H.-P. boiler for sale, good condition. Delaware Hard Fibre Co., Wilmington, Del.

Draftsman's transparent amber degree indicators. Ashland Tool Works, Ashland, Pa.

U. S. and Canada patent for sale, cheap. Address Box 240, AMERICAN MACHINIST.

Will buy or pay royalty for good patented machine or tool. Box 228, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies & Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Best of facilities for medium heavy work; contracts taken. Blanchard Mach. Co., Boston.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Wanted—Second-hand Colburn combination saw, in good condition. Address C. Birnbaum, 34 S. Water St., Cleveland, O.

For Sale—Patterns for 25 machines; goodwill 25 years' standing. F. Gleason, American & Susquehanna ave., Philadelphia, Pa.

Iron building, 40 to 50 ft. wide, 100 to 150 ft. long; prefer building suitable for light traveling crane. Box 255, AMER. MACHINIST.

For Sale—Two geared Ferracute presses, 62 in. between uprights; little used, and in good condition. Address W. H. Mullins, Salem, Ohio.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Wanted—One or two good second-hand hydraulic jacks of large capacity; give make, condition and price. Address "Hydraulics," care AMERICAN MACHINIST.

Correspondence solicited with manufacturers of engines or other machinery, who wish to improve their designs or methods and desire skilled assistance. Box 214, AM. MACH.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman desires situation. Address C. W., 53 Concord st., Brooklyn.

Draftsman, experienced in machine tools, wants a position. Box 244, AMER. MACHINIST.

Draftsman wishes position in South America or Mexico; 6 years' exp. Box 257, A. M.

A superintendent of machine and engine shop wishes to make a change; capable of handling 500 men. Box 248, AMER. MACH.

Position to take charge in factory repairing shop; 12 years' experience; vicinity of New York preferred. Box 243, AMER. MACH.

Employ me to economize production, improve designs, extend business, increase profits. Address "Know How," AMERICAN MACHINIST.

Advertising man, experienced in machinery; references; will outline plant; economical; $2,000 per year. Address. "Special," care AMERICAN MACHINIST.

Change wanted by the mechanical superintendent of a large works; age 33; 8 years in present position; best record and references. Address Box 234, AMERICAN MACHINIST.

Machinist and draftsman wishes to make a change as general foreman or draftsman; has experience on engines, hoisting and haulage engine air compressors. Address Box 246, AMERICAN MACHINIST.

Wanted—Position by mechanical draftsman who can get out work to cast and machine cheaply; well up on shop practice; wide range of work; good references. Box 249, AMERICAN MACHINIST.

Wanted—Position as superintendent of valve works or shop making oilers, lubricators, etc., by wideawake, up-to-date American; age 38; best of references. Address Box 241, AMERICAN MACHINIST.

Skilled mechanic, age 37, with 27 years' practical experience as brass finisher, toolmaker and machinist, expert on pressure regulator and reducing devices for steam or air, desires position as foreman. Box 245, AM. M.

A young man occupying confidential position in large manufacturing plant, desires to change; thoroughly familiar with machine-shop costs and piece work; best recommendations and reasons for leaving present employment. Box 247, AMERICAN MACHINIST.

Advertiser, who has had 10 years' experience in positions of responsibility in the business departments of machine manufacturing concerns, seeks a change; competent to take general management; expect a good salary for good work; 30 years old; married; best references. Box 242, AMERICAN MACHINIST.

Help Wanted.

Twenty first-class machinists wanted; steady work. Address Weber Gas & Gasoline Engine Co., Kansas City, Mo.

Wanted—Man to take charge of office and estimate department in large engine works. Box 233, AMERICAN MACHINIST.

Wanted—Draftsman accustomed to stationary engine work; steady employment and good wages. Box 232, AMERICAN MACHINIST.

Draftsman wanted; young man with ideas, to begin on a modest basis with a growing shop. Brandywine Machine Works, Wilmington, Del.

Wanted—Experienced man to lay out work for shop and do estimating on all styles of gear cutting. Address, stating terms, "Gear," care AMERICAN MACHINIST.

Wanted—General machine shop foreman, up to date, with experience on steam and gas engine work, and good references. Address Box 237, AMERICAN MACHINIST.

Wanted—At once, a lively and steady machinist, accustomed to brass pattern work; steady work and fair pay; near New York. Address Box 251, AMERICAN MACHINIST.

Wanted—A man with executive ability to superintend a brass foundry making large and small castings; must be up to date. Address "President," care AMERICAN MACHINIST.

Draftsman wanted; man acquainted with engines and steel structures; permanent position. Address, giving fully experience, reference, salary, Cole Mfg. Co., Newman, Ga.

Wanted—First-class field foreman, competent to erect stand-pipes, pen-stocks, steel stacks, etc.; state wages and references. Address "Field Foreman," care AMER. MACH.

A number of toolmakers and skilled machinists wanted, also several foremen in our machine department at our shops, Marion, Jersey City, N. J. Automobile Company of America.

Wanted—By a company located in the East, two good draftsmen with some ability as designers, who have experience in the line of steam engineering. Address Box 253, AMERICAN MACHINIST.

Wanted—An experienced chief draftsman upon brass rolling mill machinery; must be a good machine designer and able to manage a large force of draftsmen; state age, experience and salary required. "Z.," AM. MACH.

Pattern Shop Foreman—First-class foreman for pattern shop, for engine and general machinery patterns. Address, in confidence, giving references, age, qualifications and wages expected, "Patterns," care AM. MACH.

Wanted—Three or four good molders for machinery castings; standard wages and steady job offered to good, sober, industrious mechanics; state experience, age, and give references. Apply or address Kenney & Co., Scottdale, Pa.

Foundry foreman, energetic and progressive; thoroughly experienced on light and medium machine castings; small foundry; steady position with responsible firm. Address, with full particulars, Box 254, AMERICAN MACHINIST.

Foundry foreman wanted for shop running 60 floor and bench molders, on medium size work; to the right man, with ability to manage, a liberal salary will be paid. Address, in confidence, with references, Box 256, AMERICAN MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—First-class men on boring mills, planers and lathes, and toolmakers, accustomed to making punching dies for electrical work, to send for application blank and register with us. Bullock Electric Manufacturing Co., Cincinnati, Ohio.

Wanted—By well-known electrical manufacturing company in the East, a first-class mechanical designer and draftsman familiar with direct-current apparatus as applied for power purposes. Address "Manufacturer," care AMERICAN MACHINIST.

Wanted—Several good machinists for a machine shop building engines and doing general jobbing, repair, etc.; we prefer mechanics between the ages of 28 and 45; state experience, age, and give references. Apply or address Kenney & Co., Scottdale, Pa.

Wanted—Foreman capable of taking charge of stamped ware department; about 25 hands; must be an experienced die setter and thoroughly understand stamping machinery; references required; also state age, experience and wages expected. Address Box 252, AM. MACH.

Wanted—First-class layer-out for boiler